Astounding
SCIENCE FICTION
MARCH 1948
25 CENTS
. . . AND SEARCHING MIND
BY JACK WILLIAMSON
Reg. U. S. Pat. Off.

For once they actually agree!

Hope and Crosby, in the movies, seldom see eye to eye.

But there's one thing they really do agree on—they both think U.S. Savings Bonds make wonderful Christmas gifts!

SAYS BOB: "They're swell for *anybody* on your list. You couldn't pick a nicer, more sensible, more welcome present. Even Crosby knows that."

SAYS BING: "I hate to admit it, folks, but Hope is right. And remember this—you can buy Bonds at any bank or post office in the U.S.A."

BOB AND BING (together): "This Christmas, why not give the finest gift of all—U.S. Savings Bonds!"

Give the finest gift of all ... U.S. SAVINGS BONDS

Contributed by this magazine in co-operation with the Magazine Publishers of America as a public service.

A PUBLIC SERVICE PROJECT · THE ADVERTISING COUNCIL

WHAT IS THE UP AND DOWN CONTROL OF AN AIRPLANE?

ELEVATORS, you say . . . . .
WRONG, it's the THROTTLE.

WHAT IS THE SPEED CONTROL?

THROTTLE, you say . . . . . .
WRONG, it's the ELEVATORS.

WHAT TURNS THE AIRPLANE?

RUDDER, you say . . . .
WRONG, it's the WING.

HOW MUCH HORSEPOWER DO YOU USE WHEN YOU MOW THE LAWN?

DOES A CARBURETOR WORK LIKE YOUR SISTER'S ATOMIZER?

WHY WON'T IT RAIN UNLESS THERE'S ICE IN THE CLOUDS?
Even in summer.

WHY DOES AN ECHO ILLUSTRATE THE PRINCIPAL OF RADAR?

A PICTURE BOOK THAT MAKES SCIENCE LESSONS *Fun!*

You'd like to know about things like flying, jet propulsion, atomic energy, weather, navigation. Things you'll be working with in a few years. But you don't want to wade through a lot of dull text-books . . .

Here—at last—for the first time, is a book that gives you authentic and factual science IN PICTURES . . . that are as much fun to read as your favorite comic.

You'll find the answers to all your science questions *easily*, *quickly*, and with the greatest of *pleasure*, in SCIENCE IS IN THE AIR. Get it at your newsstands now—only 25c—or send in the coupon. Don't delay . . this is the 160 page scientific picture book containing more than a thousand pictures you've been waiting for! It's the book for you!

Street & Smith Publications, Inc.
Box 1
122 East 42nd Street
New York 17, New York

Please send me a copy of SCIENCE IS IN THE AIR. I enclose 25c. (30c in Canada.)

NAME .....

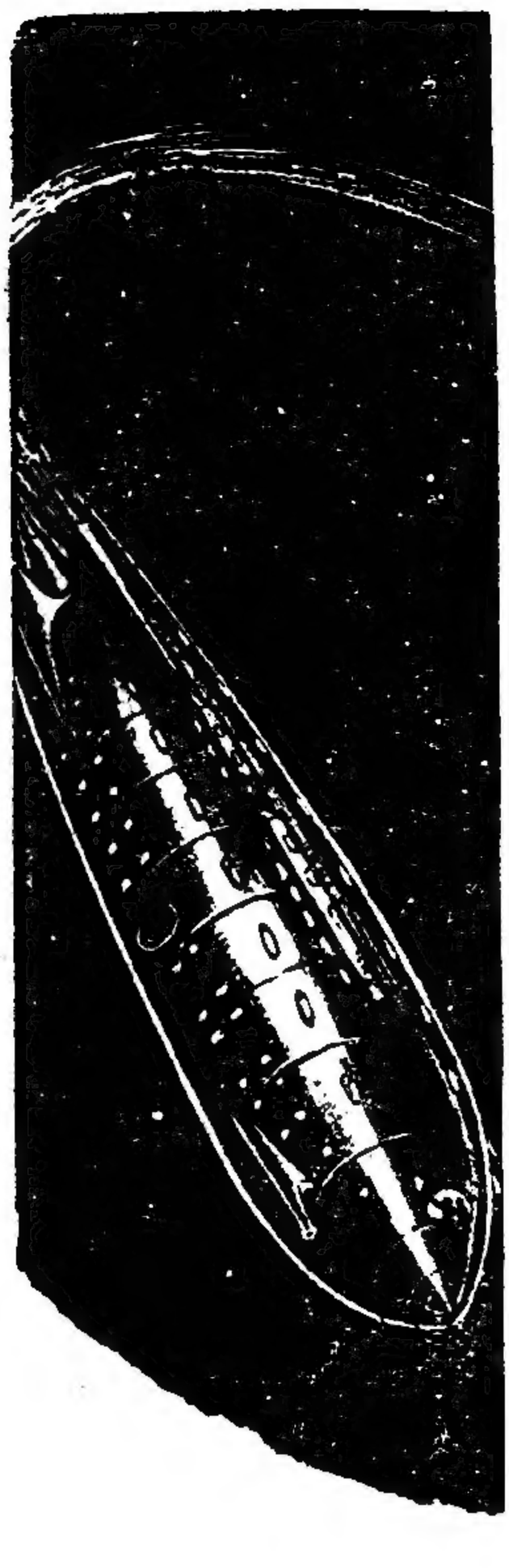
ADDRESS..... ZONE NO....

CITY..... STATE.....

SCIENCE IS IN THE AIR

25c AT ALL NEWSSTANDS

PUBLISHED BY STREET & SMITH



Astounding SCIENCE FICTION

Reg. U. S. Pat. Off.

CONTENTS

MARCH, 1948 VOL. L, NO. 1

SERIAL

...AND SEARCHING MIND, *by Jack Williamson* 7
(Part 1 of Three Parts)

NOVELETTE

WEST WIND, *by Murray Leinster* 77

SHORT STORIES

THE INCREDIBLE INVASION, *by George O. Smith* 62
HER MAJESTY'S ABERRATION, *by René Lafayette* 126
FILM OF DEATH, *by J. Scott Campbell* 141

ARTICLES

THE SPACE SUIT, *by L. Sprague de Camp* . . 108
THE ENDOCHRONIC PROPERTIES OF RESUBLIMATED THIOTIMOLINE, *by Isaac Asimov* 129

READERS' DEPARTMENTS

THE EDITOR'S PAGE 5
IN TIMES TO COME 107
BOOK REVIEW 153
THE ANALYTICAL LABORATORY 156
BRASS TACKS 157

COVER BY ROGERS

Illustrations by Ayers, Cartier, Davis and Rogers

Editor
JOHN W. CAMPBELL, JR.

The editorial contents have not been published before, are protected by copyright and cannot be reprinted without publishers' permission. All stories in this magazine are fiction. No actual persons are designated by name or character. Any similarity is coincidental.

Monthly publication issued by Street & Smith Publications, Incorporated, 122 East 42nd Street, New York 17, N. Y. Allen L. Grammer, President; Gerald H. Smith, Exec. Vice President and Treasurer; Henry W. Ralston, Vice President and Secretary. Copyright, 1948, in U. S. A. and Great Britain by Street & Smith Publications, Inc. Reentered as Second-class Matter, February 7, 1938, at the Post Office at New York, under Act of Congress of March 3, 1879. Subscriptions to Countries in Pan American Union, $2.75 per year; $3.00 per year in Canada; elsewhere, $3.25 per year. We cannot accept responsibility for unsolicited manuscripts or artwork. Any material submitted must include return postage.

$2.50 per Year in U. S. A. Printed in [redacted] the U. S. A. 25c per Copy

NEXT ISSUE ON SALE MARCH 16, 1948

STABLE ONES, TOO

During the war, the pressure of time forced the development of not one, but four different methods of preparing fissionable materials for atomic bombs. One, the one of greatest significance, is the atomic pile and transmutation to produce Pu-239 which can be chemically separated from uranium. Three other methods were installed and operated at Oak Ridge, however.

Probably the most famous of these was the gas diffusion plant, wherein uranium hexafluoride diffused through porous barriers to separate the isotopes. It's still at Oak Ridge, and will still separate U-235 from U-238. That's all it will do.

The least known method was the thermal diffusion system, a method that separated the isotopes in a liquid system, and worked at high concentration therefore. It was good, efficient at separating, but used enormous amounts of heat. The general method allows adaptation of the equipment to other isotope separation problems, if necessary.

But the most interesting of all was the *calutron* method—the method that involves use of giant mass spectrographs, simplified and beefed up for high output. It was this plant that produced the first pure U-235 for the research at Los Alamos. Unlike the other methods, each single calutron unit is relatively small, and very highly flexible, readily adapted to separating isotopes of almost any element by readjustments of electrode voltages and magnetic field strength.*

Oak Ridge is now in production on stable isotopes of over one hundred elements, the Atomic Energy Commission announces. The calutrons have been put to work again, and stock piles of all the isotopes of many elements will be available on order. Since these are stable isotopes, their use is not quite like that of the radioactives, but parallels it in many cases. In addition, many very important discoveries are almost certain to result from studying the stable isotopes, for the sheer and simple reason that they *are* stable—and it would be highly interesting to find out *why*.

However, the stable isotopes have many uses which radioactives can't handle. For instance, oxygen is certainly a vitally important element to us, yet oxygen exists in just five isotopes; atomic weights 15, 16, 17, 18, and 19 have been prepared or detected. The 15 and 19 isotopes are radioactive —but the half-lives are measured in

* The calutron is described in detail in the book "The Atomic Story."

seconds, and very few seconds at that, in relation to the time required for a chemical process—126 for the oxygen-15 and 31 for O-19. Problem: All life on earth is directly or indirectly dependent on the photosynthetic reaction $CO_2 - H_2O$ yields sugars and free oxygen. But—does the free oxygen come from the water or from the carbon dioxide—how does that reaction proceed? The radio-oxygens are far too evanescent for that; the very rare stable isotopes must be used as tracers instead.

Or again, copper is important somehow in plant metabolism. But it takes a full season to allow a plant to absorb and utilize copper from the soil—and the longest-lived radiocopper has a half-life of only 12.8 hours. But a rare stable isotope can be concentrated at Oak Ridge.

Another point: One of the problems of power piles is that only low-melting metals—lead, bismuth and aluminum—are known to refrain from absorbing vital neutrons. But perhaps one of iron's several isotopes is a nonabsorber—and a very special steel could be used in the pile, if made from that isotope.

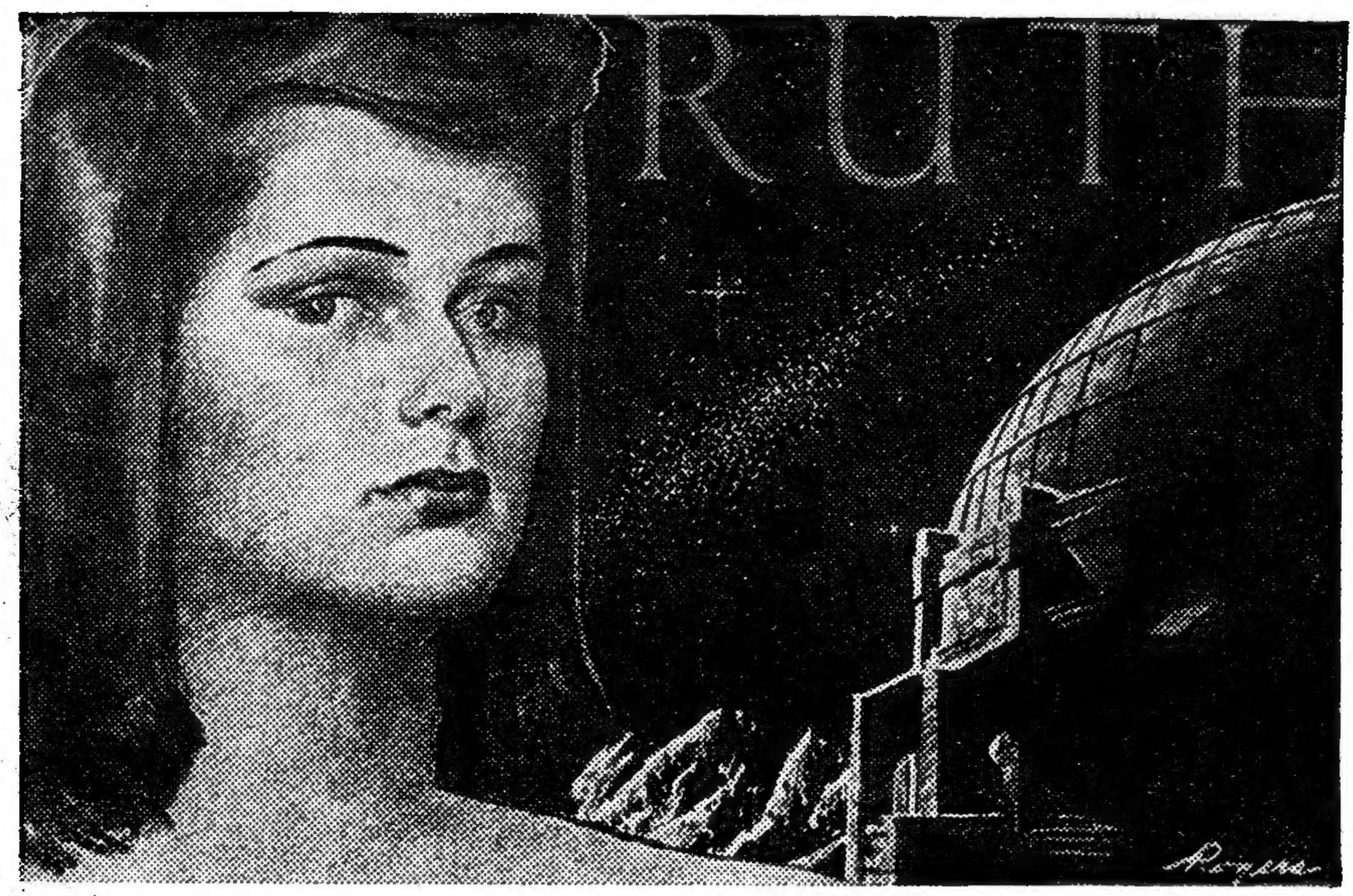
Finally, if a process is so selective it will pick out separate isotopes of one element, it will most definitively separate two elements. If you can separate iron-54, you will not only have a source of useful iron isotope, but will also have, for the first time in history, *really* pure iron—iron without impurities of cobalt, nickel, manganese and half the elements in the table. And that's something transformer metallurgists would dearly like to possess. They'd be perfectly happy to manufacturers, spectroscopists, and take the separated pure isotopes and put them back together to make the natural distribution of iron isotopes—if they were just one hundred per cent *iron*.

When copper is cooled to a few degrees above absolute zero, its conductivity becomes practically infinite. But—what are the effects of single isotopes as conductors?

The spectrum of an element is determined by the arrangement of electrons—but there are fine details of the spectrum that are dependent on the nucleus, and those details vary from isotope to isotope within an element. With sufficient quantities of purified isotopes to work with, spectroscopists will be able to learn more about the spectra of elements, and nuclear physicists will get more information about nuclear structure.

These separated isotopes are not as cheap as radioactive isotopes, generally speaking. For instance, purified mercury isotope Hg-198 is now being used to produce a spectrum one line of which will probably be the new international standard of length. But this Hg-198 is being prepared at Oak Ridge, not by separating the Hg-198 from the natural mixture of Hg isotopes, but by transmutation of gold's single isotope—natural gold is one hundred per cent Au-197—to Hg-198 by neutron bombardment in the atomic pile. (And enough, it is, to drive an ancient alchemist mad!) The transmuted gold is being prepared by the gram, which strongly suggests that you'd better make sure of your bank account and the Oak Ridge price sheets before ordering a pound or so of purified Fe-54 iron!

THE EDITOR.



...AND SEARCHING MIND

BY JACK WILLIAMSON

***First** of three parts. When the robots came, they stopped all humanity's strivings—man stood "With Folded Hands . . ." But that was* precisely what man needed—*though he hated it!*

Illustrated by Rogers

I.

The granite-faced sergeant of the gate detail found her standing timidly outside the tall steel barrier. She was a grimy little waif, in a cheap yellow dress. Her bare brown feet shuffled uncomfortably on the hot asphalt.

"Please, mister, is this the Starmont Observatory?" She seemed breathless and afraid. "Can't I see the director? Dr. Claypool?" Her huge grave eyes shone wet. "Please, mister! 'Cause it's awful important."

The sergeant scowled at her doubtfully. She was about nine,

he thought, though she looked too small and yet somehow too old. She wore a tattered scrap of scarlet ribbon, bravely, in her straight black hair. Her bluish face looked pinched and hungry. She watched him through the heavy steel mesh, with pleading liquid eyes.

But stray urchins didn't see Dr. Claypool.

"Not without a pass." She flinched from the rasp of his voice, and he tried to smile. "Starmont's a military reservation, see?" She had touched his soft spot, somehow, and he tried to warm his tone. "What's your name, sister?"

"Dawn." She lifted her thin voice, stoutly. "Dawn Hall—an' I've just got to see him!"

"How'd you come here?"

The leather-cheeked sergeant squinted past her, at the narrow road that twisted down the flank of the solitary mountain and lay straight and black on the tawny desert below. The first settlement was twenty miles away, too far for a child to walk. But he could see no vehicle.

She piped firmly: "Mr. White sent me."

"And who is Mr. White?"

An utter devotion illuminated her enormous, brimming eyes.

"Mr. White is a philosopher." She stumbled on the word. "He has a red, bushy beard, and he came from other places. He took me out of an awful house with iron windows. He's good to me, and he teaches me tele—" She gulped. "He sent me to see Dr. Claypool."

"What about?"

"To give him this." Her skinny hand came briefly out of the pocket of the yellow dress, and the sergeant glimpsed a gray card clutched in her thin grubby fingers. "It's a message—an' awful important, mister!"

"You might send it in," the sergeant said helpfully.

"Thank you." She shook her head, solemnly. "But Mr. White said I shouldn't let anybody see it, 'cept Dr. Claypool."

The sergeant frowned.

"I told you, sister—" He saw the hurt on her tight blue face, and tried to soften his refusal. "Dr. Claypool is a big wheel, see? He's busy, see? I'm sorry, sister—but I can't let you in."

"I understand," she whispered forlornly. "Let me—think."

For a moment she stood still, forgetting even to move her feet on the hot pavement. Her black head tilted and her eyes half closed, as if she listened to something far away. Then she nodded, and whispered something, and looked wistfully back through the barrier.

"Please—may I see Mr. Ironsmith?"

"Sure, sister!" The sergeant gave her a leathery smile, relieved. "Why didn't you tell me you know him? Claypool's a big wheel, but anybody can talk to Frank Ironsmith. He ain't important—and he's a friend of mine. Just wait a minute. Come around here in the shade, and we'll talk to Ironsmith."

Grateful and timidly silent, she came up under the narrow awning

in front of the guard box. The sergeant picked up his telephone and called the observatory switchboard.

"Sure, Rocky, Frank Ironsmith has a phone," came the operator's adenoidal whine. "He works in the computing section. Starmont 88.' Sure, he's in—he just bought me a cup of coffee at the cafeteria. Just hold the line, will you, Rocky? Sure, Rocky, sure!"

Ironsmith listened to the sergeant, and promised to drop right down. Waiting for him, the little girl stooped to pick gaudy yellow flowers from a rank desert weed that grew outside the fence. She sniffed their loud perfume with a gentle murmur of pleasure, and then peered wistfully back through the tall barrier at the lawns and the dark evergreens that made Starmont a cool oasis. She lifted one grimy foot and then the other, gratefully wiggling her small toes to cool them in the shade.

Her hot fingers kept their tight grip on the card in her pocket, and she looked uneasily back to the sergeant again, tiny and alone.

"Don't you worry, sister." The sergeant tried to smooth his rusty voice. "Because Frank Ironsmith is a good guy, see? He's no big wheel—he just runs some machines that work problems, in this computing section. He isn't important, and I guess he never will amount to much. But I think he'll try to help you."

The little girl listened, solemn-eyed and troubled.

"I've known him six years, see," the sergeant said. "I was just a corporal, when I came here with the first guard detachment. And Frank was just a clerk, then, in this new computing section. These big wheels like Claypool haven't got much time for soldiers, but Frank was friendly, the first time we met. We used to drink a couple of brews together, and talk things over."

The child listened hopefully, as if she understood.

"They were having trouble in the section, see." The sergeant liked to talk, and he wanted to calm her fears. "Claypool had just got the government money, see, to put in these big calculating machines and hire a staff to run them. He had an astronomer in charge, with a chief computer and about four assistants.

"And Frank was just a clerk."

Even Einstein, on the far mother world and long ago, had once been just a patent office clerk. Sergeant Stone didn't know that, and he wouldn't have cared. But he told the timid child:

"They didn't know what Frank could do. And they were neck-deep in trouble, see? All those expensive machines seemed to have errors built into them. The new section was supposed to do all the math for the whole observatory, and these new military projects, too. But those mistakes cost a lot of time and money, and the work kept piling up. Finally, Dr. Claypool had the instrument company send out an expert."

The sergeant's weather-beaten face beamed tenderly.

"And what an expert! She

turned out to be a tall brunette—as slick a chick as a man could want to feast his eyes on. Her name was Ruth something—Frank introduced us, once when he brought her to lunch at the cafetèria. She was really stacked up. But I guess she knew her stuff, all right.

"There was nothing wrong with any of those machines, she said. Nothing except the staff. She told Claypool to transfer the astronomer and the chief computer and all the assistants, and let Frank take over. I guess Claypool was kind of startled, but he was getting desperate. He said Frank could have a go at it.

"And it turned out Frank could do the work, all right. As soon as Ruth showed him how, he could get out six times as much work as all that staff did, and never seem to try. He doesn't make mistakes, either. I guess Frank will never amount to much, but he does have a wonderful knack for figures—"

The sergeant grinned fondly.

"Ruth had quite a figure of her own," he said. "And I always thought Frank could have done all right with her, if he had just been a little more ambitious. She stayed around to teach him to run those machines—stayed a lot longer, I think, than necessary. Because pretty soon Frank could show new tricks to her.

"I think they could have made a mighty fine pair."

The sergeant sighed wistfully.

"But then one day Frank told me Ruth was quiting her job with the instrument company, to marry Dr. Claypool. That knocked me over, because she had been going around with Frank. And I always thought Claypool was a little too old and sort of stuffy for such a lively bit of fluff.

"But you can't ever tell."

The sergeant shrugged wisely.

"I guess she figured Claypool was a better catch, because he was already rich and famous, even then—and that was before he got up to his neck in this secret military work. I guess she could see that Frank would never amount to much. But I always thought, somehow, that she and Frank could have made a mighty happy pair."

Sadly, the sergeant shook his head.

"Oh, I guess Ruth has done all right. Claypool has plenty, and he always gives her anything she wants. But she went to work in the business office, a couple of years ago—just to kill the time, I guess, because Claypool is always too busy to be with her very much.

"Anyhow, I always thought Frank should have had her. I used to tell him he could have got her, if he had just tried a little harder. Claypool would have to pay him ten times what he gets, if he'd just ask for it—there aren't many men can run those machines the way Frank does.

"But Frank always takes it easy. I know he wanted Ruth, but he didn't seem upset when Claypool got her. He didn't seem to worry. That's one thing you like about Frank. He never seems to worry over anything."

The sergeant grinned encouragingly, at the lonely little girl.

"See?" he insisted. "Frank's O.K.—and here he comes!"

And Ironsmith came down to the gate, along a shaded gravel path from a little red-shingled building among the evergreens, riding a rusty bicycle. He waved a genial greeting to the sergeant, and looked at the child with keen gray eyes. She smiled at him uncertainly.

A boyish twenty-six, Ironsmith had untidy sandy hair. He wore a faded shirt, open at the collar, and shapeless, ancient slacks. He answered the little girl's timid smile with a sunburned, cheerful grin.

"Miss Dawn Hall," the sergeant said gravely. "She wants to see Dr. Claypool. I told her you might help her, Frank."

Ironsmith tapped the bowl of his underslung briar against the bicycle frame, and stood carefully testing its temperature with his fingertips. He saw Dawn's hopeful urgency, and shook his head with a quick regret.

"You'd have to be at least a general." His voice was soft and kindly. "Wouldn't anybody else do at all?"

"Nobody," she insisted solemnly. "An' it's awful important."

"I'm sure," Ironsmith agreed. "And what might it be about?"

The child's great, limpid eyes stared beyond him. Her thin blue lips moved silently. Her dark head tilted, with a flutter of the gay red ribbon, listening.

"I'm not to say." She looked earnestly back at Ironsmith. "'Cept it's something Mr. White says is going to happen right away. Something awful bad! That's why I've got to see Dr. Claypool."

Ironsmith peered beyond her, down the long empty road to the desert. His puzzled eyes saw the uncomfortable shifting of her bare, chapped feet, and he smiled at her sympathetically.

"Tell me, Dawn—where did you leave your folks?"

"I don't have nobody," she piped brightly. "An' the cops shut me up in a big dark house with bad smells and iron windows. But I'm all right now, 'cause Mr. White and his friends took me out through the walls."

Ironsmith rubbed his smooth boyish chin thoughtfully.

"Dr. Claypool is pretty hard to see," he told her cheerfully, "but maybe we can manage something. Suppose we go over to the cafeteria, and have some ice cream while we talk this over." He looked at the sergeant. "I'll see her back to the gate."

But the little girl stood again as if listening to something far away, and then shook her head reluctantly.

"Aren't you hungry?" Ironsmith urged. "They've got four flavors."

He could see the eager longing in her wet black eyes.

"Thank you," she said softly. "Yes, I'm awful hungry. But Mr. White says I haven't time to eat."

She turned firmly, and started away from the gate. Beyond her the black empty road was a narrow shelf blasted into the ancient basalt

face of the mountain, and the nearest human dwelling was a dark smudge rippling with desert heat on the far horizon.

"Wait, Dawn!" Ironsmith felt puzzled, and anxious for her. "Where're you going?"

"Mr. White says I must find Dr. Claypool, right away." She gulped. "But I'm awful sorry, about that ice cream."

Pushing the card deep in her pocket, she ran on down the narrow pavement. She kept close under the cliff, trying to step in the narrow streak of cooler shade.

Ironsmith stood watching her, with an increasing troubled concern. She was a daughter of misfortune. Hunger had made her body too small for her head, and the stoop of her thin shoulders gave her almost the look of a little old woman, as she ran.

He didn't understand her. Her fearful determination puzzled him, and her odd way of listening to nothing. Rules or not, he began to wish he had tried to get her in to see Claypool.

In a moment, her bright yellow dress and her fluttering ribbon were gone beyond the first dark jutting angle of the mountain. Ironsmith mounted his bicycle, and then something stopped him. He waited, watching another curve of the road that lay in view beyond, but the running child didn't come in sight again.

"Let me out," he told the sergeant suddenly. "A homeless kid, with that crazy notion about seeing Claypool—we can't just let her run off in the desert. I'm going to bring her in. I'll be responsible."

He rode down around the turn, and on for a mile beyond. He didn't find the child. Presently he came back to the gate, walking to push the cycle up the grade. The sergeant stood scowling down the empty road.

"Where'd she go?"

"I don't know." Ironsmith paused in the gate, to mop dusty sweat off his pink worried face. "But she's gone."

"I kept watching the road, and I didn't see her anywhere." The sergeant scratched his head, and then automatically set his cap back to the proper angle and checked his buttons and his tie. "A funny thing," he concluded vehemently.

II.

Dr. Webb Claypool was not an easy man to see—not unless you happened to be a general on a confidential mission, or another distinguished scientist armed with proper credentials from the Security Police. For his own discoveries had made Starmont a guarded arsenal.

Before the Crater Supernova blazed out to dim the stars, five years ago, Claypool had been only a renowned astronomer. Then thirty-five, he was a slight, shy, brown-eyed gnome, wistful with his deep thirst for truth, and already secure in the snug little aristocracy of science. The ascending path of his career looked bright ahead, and

Ruth had just forsaken her integrators to marry him.

The new star cut short their honeymoon, and changed everything. Very young and very serious about the rites of life, she had planned the honeymoon. They went to the little coast town where she was born, and that evening they had driven out to an abandoned lighthouse and carried their picnic basket down the cliffs to a narrow scrap of beach beneath.

"That's the old Dragonrock Light." They sprawled on their blanket in the dusk, her dark head pillowed on his shoulder. Happily, she was introducing him to her fondest childhood recollections. "Grandfather used to keep it, and sometimes I came—"

Then he saw a faint cold light on the cliffs, and turned his head and found the star. It took his breath, with its hard violet splendor. His memory of that moment was always poignant with the cold sting and salt taste of spray from the breakers, and the sharp smoke of damp driftwood smoldering, and Ruth's perfume—a heavy scent called Sweet Delirium. He always recalled the blue glitter of the star's thin light, in her first tears.

Because she cried. She was no astronomer—she knew how to set up and check an electronic integrator, but the Crater Supernova was only a point of light to her. She wanted to show Claypool these places that were hallowed by her childhood, and it hurt her that some silly star should interest him more than the depth of her first tender love.

"But look, darling! A man could wait five hundred years for a chance like this—a supernova in our home Galaxy. Think what it means!"

He tried hard to make her see.

"Think of a star—a great atomic engine! For millions and billions of years it runs, pouring out its measured energy. Sometimes, adjusting its equilibrium, a star flares up with heat enough to melt its planets, and you have an ordinary nova. But a very few stars go somehow—wrong. Stability fails, altogether. The star explodes into billions of times its normal brightness, and completely changes its state. The thing is an unsolved mystery—as fundamental as the failure of the binding force that lets an atom split."

The red glow of the fire touched warm glints in her hair, but the thin light of the star was cold on her hurt white face, and it made hard blue diamonds of her tears.

"Please, darling!" He gestured eagerly at the violet star, and saw that his arm cast a hard black shadow from it on her wounded face. Its stellar magnitude, he estimated, must already be nearly minus six!

"I've been watching this star, and I'm ready for it," he told her breathlessly. "I've had special equipment ready at Starmont for several years—just in case. It can answer questions for me. It might tell us—anything! So, please, dear—"

She yielded then, as gracefully as

she could, to his more urgent passion. They left their basket and their blanket forgotten on the beach, and drove hard across the coastal range to reach Starmont before the star had set. She went with him into the whispering gloom of the observatory, and watched with a hurt wonder as he toiled so frantically to set up his special spectrographs and expose his plates while the seeing lasted.

Claypool's flash of intuition, when it came, was as dazzling as the supernova's light. It illumined the cause of that stellar engine's wreck, and revealed a new geometry of the universe, and showed him a new meaning even in the familiar pattern of the periodic table of the elements.

In his first hot fever of perception, he thought he had seen even more. Trembling with a breathless weakness, he dropped and smashed the best set of plates, which clearly showed the rhodomagnetic displacement. He broke his pen, covering yellow pages with frantic symbols. Coatless in a chill blue dawn, he ran out of the observatory and roused Ironsmith to check his work.

For one hour of mad illusion he felt in his grasp the ultimate answer to all the riddles of the universe. He stalked the mountain dawn, hatless and impatient, drunk with the supernal wonder of it—until the young mathematician came cycling after him, grinning cheerily, to point out his staggering error.

For all that humiliating blunder, however, he had learned enough to change history and wreck his stomach and slowly blight his marriage. For the corrected equation still described a new energy-spectrum. He soon discovered that the elements of the rhodium triad were the key to it, as iron and cobalt and nickel had always been to all the familiar wonders of electromagnetism. He sent a few more problems to the computing section, and evolved the terrible technique of total mass-conversion.

That was five years ago.

Ruth had made and postponed many plans for them to finish that interrupted honeymoon, but he had never found the time to go. Now she never talked about it any more. The Crater Supernova was gone long ago, faded to a telescopic puff of exploding nebular debris, but the cold violet light of it had changed his life. Things were different, now, and Dr. Webb Claypool was a hard man to see.

He was protected from casual callers—from murderous Triplanet agents as well as from barefoot waifs—by an inner fence, with a second guarded gate. That fence surrounded a squat, domed fortress, of gray concrete. Searchlights flooded the fence and the building by night, and armed men watched always from four guard towers.

The Security Police discouraged all talk of the activities inside that fence. Six technicians worked there, under Claypool's direction. They slept in the building, ate in their own mess hall, and went about by watchful twos. If they ever mentioned their duty there, they called it just "the project."

Those guarded activities composed a two-layer secret. The flat dome on the surface housed Project Lookout. That installation was known to the general staff and the Defense Authority. It was supported by unlimited sums from unaudited discretionary funds, and shipments of expensive equipment which were dropped from accountability.

Nominally, Project Lookout existed to detect any tests of atomic or mass-conversion weapons, on the neighboring planets or at space. Tiny, rectangular spider webs of redly glowing wire revolved ceaselessly and slowly in huge, squat tubes under the dome, sweeping space. The black-cased directional trackers clucked softly to each detected neutrino, plotting its origin.

Project Lookout was really functional. Claypool himself had designed the search tubes—after the computing section had solved problems enough to predict the rhodomagnetic effects of neutrino decay. Every neutrino that passed those glowing grids printed its own record, and every nuclear reaction within the vast range of the tubes betrayed itself with a spray of those most elusive particles.

The whole search project, however, was intended for a blind. The military satellite stations above the atmosphere were better situated to pick up gamma rays from mass-conversion weapons. The chief function of Project Lookout was merely to hide the deeper secret of Project Thunderbolt.

Project Thunderbolt was a weapon—of the last, most desperate resort. Only nine men shared its dreadful responsibility. Six were the youthful technicians, physically hard and mentally keen, picked and trained for an appalling duty. The other three were the world president, the defense minister, and Claypool himself.

And Ironsmith?

If that cheerfully indolent mathematician drew any unwise conclusions from the problems brought to the computing section, he kept

such thoughts to himself. The Security Police had explored his past, in their routine loyalty-check of the Starmont staff, and found no mark against him. He idled through his work, and idled about the mountain on his rusty cycle; and he didn't seem to matter.

Project Thunderbolt was hidden underground. The cloakroom behind Claypool's office in the search building was a disguised elevator. The shaft dropped a hundred feet, to a concrete vault in the heart of the mountain. All the blasting and construction had been done by his own technicians, to maintain security. The launching tube ran up through the search building, masked as a ventilator shaft, and the shining missiles racked beneath it in the vault were the deadliest things that men had ever made.

The day that persistent urchin came, Claypool was working in the machine shop beside the launching station in the vault, alone. The six young men of his staff were trained to set and launch the missiles, and the big sealed safe behind him held all the specifications—lest some Triplanet assassin should succeed—but he had dared trust no other with the full details of war head, drive, and pilot.

Sleek with the clean beauty of precision machinings, the tapered thing before him on the bench was smaller than any of the old atomic weapons. But its war head was calculated to shatter the crust of a planet. Its rhodomagnetic drive could exceed the speed of light. The relay-grid of the pilot-mechanism invested it with a ruthless mechanical intelligence.

"Please, mister!"

The little girl came timidly out of the automatic elevator, behind him, walking on bare silent feet. One grimy paw was deep in the pocket of her yellow dress. The tattered ribbon in her black hair made a scarlet banner of courage, but her voice was dry with apprehension.

"Please—are you Dr. Claypool?"

He started with incredulous alarm. His jewelers' lens fell and clattered with a shocking sound on the steel floor, and rolled through a ladder well down into the power plant on the level below. Not even the staff members were allowed to enter this vault, except on duty. Claypool staggered upright, barking sharply:

"Who let you in?"

By nature he had been a mild and kindly man. He was still a wistful, harmless-seeming little gnome, slight and brown and nearly bald, although acid worry had already etched his features sharp and furrowed them with a perpetual frown. He and Ruth had even dreamed of children, once, before Project Thunderbolt became his jealous mistress.

But he caught his little sleep on a cot beside the launcher, now, and taxed his digestion with a diet of coffee and hurried sandwiches and vitamin pills. Even when he could escape for a visit outside the fence, to the pleasant house in the tall evergreens, that dreadful mistress followed him.

For all security and peace were

doomed by the very being of Project Thunderbolt. Power demands its price. The master of such a weapon must be steeled to use it instantly, or else to perish by it. Claypool seldom dared to leave the teleprinters which might bring fearful news from the warning net.

Only in that buried vault could he find a sense of desperate safety, shielded with every possible device, ready to strike back at any aggressor with his planet-smashing missiles. Now the child's frightened voice had demolished that uncertain security.

"Who let you in?" he rapped again.

His voice went up, too shrill. The shock of this incredible intrusion staggered him with consternation. Sensitive to odors, he caught a penetrating rankness, and he saw the handful of loud yellow-flowered weeds which she clutched in one dirty little fist. He must have made some threatening gesture, for the urchin began to cry.

"Nobody—" She stammered and trembled and gulped. Big tears started down her pinched cheeks, and she dropped the weeds to smear them with her fist. The loud reek of the ragged blooms made Claypool faintly ill. "Please don't be mad, mister," she whispered, "'cause nobody let me in."

Claypool had seen Triplanet spies, trapped and waiting for the firing squad. He had nightmares, when he thought Project Thunderbolt had been betrayed. But this shivering, big-eyed waif didn't look as if she had come to kill him, and he tried to soften his angry, unbelieving voice.

"Then how did you get here?"

"Mr. White sent me." Shyly, she offered him the gray card. "With this."

Claypool kicked away the nauseating weeds, and sneezed once to their pollen. Trembling with his own alarm, he took the card from the frightened child. It was grimy with her small fingermarks. Blue printing on it ran:

A. WHITE, PHILOSOPHER

Underneath the name, written in bold blue script, was the word *over*. He looked on the back of the card, and found a brief, disturbing message:

Dear Claypool:

We share your concern for the safety of these endangered planets, and now we need your help. We have distressing and vital information. Come alone to the old Dragonrock Light, or bring Frank Ironsmith—we trust no one else.

A. White

He heard the child's bare feet pattering on the steel floor, and looked up in time to see her run back down the dim-lit tunnel, and slip into the elevator. He caught his breath and darted after her, shouting at her to wait. But the automatic door closed in his face, and a green arrow lit to show that the elevator was going up.

Shaken with a cold alarm, Claypool ran to the telephone on the shop desk, and called the two tech-

nicians on duty in the search dome above. They assured him that they had seen no intruders, certainly not a small girl in a yellow dress. But they were waiting, with drawn pistols, when the elevator came to the top of the shaft.

The two young men flung up the cloakroom door, rapped out a warning, and rushed into the little cubicle. It was unmistakably empty. There was nowhere to search, though they shook and prodded the garments on the cloakroom hooks. They found no waif in yellow.

They found nobody at all.

III.

Claypool was a man of reason. He was used to dealing calmly with technological marvels, and he preferred to ignore anything which failed to fit the ordered pattern of physics. He felt no particular wonder at the planet-shattering missiles of Project Thunderbolt, because they were part of that pattern.

But little Dawn Hall didn't fit.

The grotesque impossibility of her visit left him numb and cold. He restrained himself from starting up the escape ladder beyond the emergency door, and kept his shuddering finger on the elevator button. The laggard cage came back at last, and he went up to find the two puzzled technicians, Armstrong and Dodge, waiting for him in the search building.

"Did you catch her?"

Staring oddly, Armstrong shook his head. "Sir, there has been nobody here."

The man's voice was too courteous, too flatly formal, his level gaze too penetrating. Claypool felt a sudden sickness—and sneezed again, from his allergy to those ragged yellow weeds the child had brought. He insisted hoarsely:

"Somebody brought that elevator up."

"Sir, nobody went down." Armstrong kept on staring. "Nobody came up."

"But she was—down there!" Claypool croaked. These men knew the intolerable strain upon him always. Perhaps it wasn't strange for them to think that he had cracked. But he insisted flatly: "Armstrong, I'm sane—yet."

"I hope you are, sir."

The man's eyes were bleak, unconvinced.

"We've searched the place and phoned the guards," reported Dodge, equally doubtful. "There is nobody inside the fence, except the staff. Nobody at all has been admitted through our gate, today." He glanced behind him, uneasily. "But there *is* one funny item, sir."

"Eh?" Claypool tried to keep his voice from trembling. "What's that?"

"It may not mean a thing." Dodge shrugged, in a taut bewilderment. "But Sergeant Stone, on the outside gate, says he did see a small girl he didn't recognize—he didn't notice the color of her dress. She asked for you, and then she talked with Ironsmith. Stone says he didn't let her in, and he doesn't know where she went. He says she had a card—"

Claypool caught a grateful breath.

"Here it is!" He displayed the gray card, soiled with small finger-marks. The two men studied it silently, and he saw the dark suspicion fade from Armstrong's eyes.

"Sorry, sir."

"Can't blame you." Feebly, Claypool answered his apologetic grin. "Now we can get to the problem."

They all went down again, to search the vault, and found no intruder. The great safe was still intact, plastered with unbroken seals. The long missiles lay safe in the racks. But Claypool triumphantly gathered up the yellow weeds the child had dropped, and sneezed again.

"This math expert?" Dodge was scowling. "How does he come in?"

"We'll find out."

Claypool picked up the desk telephone, and told Ironsmith to meet him at the inside gate. They hurried silently up, and out. Alert men in the towers watched them silently. Two guards at the gate waited for each of them to whisper his own code word, and finally let them out.

Ironsmith came down to meet them promptly, riding his rusty cycle and contentedly chewing a cud of gum. He grinned at Claypool, saw the tight faces of the men with him, and sobered suddenly. Claypool greeted him with a hard demand:

"What about this little girl?"

"Who?" Ironsmith stepped off the bicycle, and his gray eyes widened. "Did *she* come back?"

Narrowly watching the young man's boyish, open face, Claypool suddenly realized how far Ironsmith had been trusted. A sick panic took hold of him. He had met the patient, deadly cunning of the Triplanet agents, fanatic with their dark ideology of guile and terror. A sudden wild fear of this smooth-faced youthful man narrowed Claypool's eyes, and tightened his voice.

"All right—who is she?"

"I never saw—" Ironsmith glimpsed the drooping weeds, clutched in Claypool's hand, and started slightly. "She had those!" he whispered. "I saw her pick them, outside the fence."

Claypool searched his pink bewildered face, and handed him the gray card. He read it, and shook his sandy head.

He looked up with widening eyes at the tall steel fence and the guards in the corner towers. "I can't imagine—" He caught his breath, and returned the card. "But I'll go with you to Dragonrock Light."

Armstrong protested instantly:

"That's for the Security Police. Our job is here—not playing games with Triplanet spies!" A sudden apprehension shook his voice. "Sir, you wouldn't think of going?"

Claypool was a man of science. He prided himself on the clear logic of his mind, and felt only scorn for intuition. It surprised him, now, that he yielded to a reckless impulse.

"I'm going," he said.

Dodge tried to dissuade him, with obvious common sense.

"If this White had any honest purpose, he could contact you in some ordinary way. I don't like the look of all this funny business, sir, and your life is too valuable to risk. I say call the police."

But the project, after all, was a military force, and Claypool held command. He listened carefully to every objection, but still he wanted to know how that little girl had come and gone. If strangers could enter that guarded vault at will, personal risk no longer mattered. He gave his soft-voiced orders, and Armstrong and Dodge began loading a gray-painted official car with an arsenal of portable weapons.

"Stand by, at the launching station," he instructed the rest of the staff. "Two off and two on. Watch the printers for a Red Alert. If these people are Triplanet spies—we may have to smash their planets first!"

The car was ready, when Claypool remembered a promise to eat lunch with Ruth. Still only lightly touched with time and disappointments, still tall and proud and charming, Ruth had tried to accept his secret mistress cheerfully, and she tried to fill her empty days.

She had taken over the financial management of the observatory with a cool, brisk efficiency; and he called her at the main office, now, to say that he had no time for lunch. He tried to sound casual, and Project Thunderbolt had parted them a hundred times before, but she must have heard the anxious tension in his voice.

"Darling!" she broke in sharply. "What's the trouble?"

"Nothing, dear," he lied uneasily. "Nothing at all."

And he hurried back to the men in the car.

They stopped for Ironsmith. No trained fighter, the mathematician would probably be useless in a trap—Claypool simply wanted to keep an eye on him. He couldn't understand Ironsmith's part in the picture, or forget his sick suspicion that Ironsmith had been trusted too far.

Sergeant Stone saluted respectfully, and Claypool paused to question him again. But years in the service had taught him the protective value of ignorance, and he couldn't recall anything unusual about the little girl.

Tense at the wheel, Claypool drove down the twisting road to the desert, and westward over the coastal range. Beyond the mountains, they came down through a wall of chill gray fog, to the salt smell and the dull roaring of the sea. Somberly wistful with stray thoughts of the Crater Supernova and his broken honeymoon, Claypool turned south on the coast road.

The round stone tower of the old Dragonrock Light loomed up at last, dim and lonely in the mist. It stood on a drowned ridge of ancient granite, which stabbed like a broken spear into the sea. Years of storms had shattered the old causeway from the mainland, and Claypool parked against a yellow-painted barrier set up to stop un-

wary motorists from driving off into the sea.

He got stiffly from under the wheel, already shivering from the damp west wind. Ironsmith joined him, opening a fresh packet of chewing gum and passing it amiably. His clean-shaven face had a look of casual bright expectancy, and he didn't seem to feel the chilly wind.

"Better take pistols, sir," suggested Armstrong.

But Claypool shook his head. If they needed any weapons, pistols wouldn't be enough. And he didn't much want to arm Ironsmith—who seemed far too calm and cheery.

"Give us an hour." His voice was flat and taut. "Keep your rockets ready. If this is a trap, they'll try to get away. If you see a boat or plane attempting to leave, fire without warning. And if we're not back in one hour, exactly I want you to blow that tower off the rock!"

"Yes, sir." Armstrong looked at his watch, and began loading bright projectiles into a portable launcher. Dodge was wrestling a tripod into place, in a ditch beyond the road. Claypool gave those two hard and able men a little smile of confidence, and then looked sharply at Ironsmith.

Waiting for him, that idle young man was casually absorbed in the view of ragged black cliffs and surging white water. He folded the stick of gum into his mouth and tossed away the paper wrapper. Annoyed at his easy calm, Claypool curtly told him to come along.

Grinning pleasantly, Ironsmith stepped briskly ahead to lead the way down a wet uncertain path, along the granite spine where the old causeway had been. Before them, the ruined tower stood dark in the fog. The breakers crashed into lifting plumes of foam, on fangs of rock a hundred feet below.

Claypool shivered from the damp wind. He paused to sigh, when he came in view of the narrow beach where he and Ruth had first seen the new star, and then stumbled on breathlessly to overtake the striding younger man. He looked back once, but the car was already dim and remote in the mist behind.

They came along that slippery path to a kind of gigantic stair, formed by the remaining stones of the old causeway. The steps were two feet high, leading up to the old round tower on the headland. Ironsmith ran up them, too easily, and Claypool began to regret his impulsive decision.

He began to think of what might happen, if this should be a Triplanet trap. Armstrong and Dodge would be too far behind to help. Ironsmith would be useless—if not an enemy. A light motor craft could shove off safely behind the tower, with one or two prisoners aboard, and vanish in the fog. Before that hour was ended, the bleak thought struck him, he might be safe aboard some daring Triplanet space raider, waiting under the water off the coast.

"Come on, come on!"

The child's voice came down through the fog, thin and small as some plaintive bird-call above the whine of the wind and the mutter

of the sea, and then he saw her standing at the top of that great, rough stair. She was tiny and alone. The mist-laden wind whipped her thin yellow dress, and her skinny knees were blue and shaking with the cold.

IV.

Claypool climbed on, breathless and uneasy.

"Please be careful!" came the child's warning treble. "The rocks are slick and wet." The gusty wind blew her tiny voice away, and then he heard again: ". . . waiting for you. Mr. White says he's very glad you came."

Ahead of him, young Ironsmith ran up the spray-drenched rocks to the little girl. He grinned at her, his smooth face pink and shining from the cold spray, and murmured something, and gave her a stick of chewing gum. She thanked him gravely, and Claypool thought they seemed too friendly.

He didn't like the look of things, but he toiled on upward, tight-lipped and grim. Ironsmith turned back, amused at his labored breath, to help him up the last high step, and he tried to suspend his harsh suspicion.

Dawn Hall greeted him with a timid nod. Trustfully, then, she offered Ironsmith her grimy little paw, and led them toward an open archway in the base of the old tower.

"Oh, Mr. White!" she piped eagerly. "Here they are!"

A huge man came stalking out of that dark doorway. He towered a whole head above Claypool, and he had a kind of vagabond splendor. His flowing hair and magnificent beard were a fiery red. The angular planes of his ruddy face showed a stubborn, massive strength.

"I knew you'd be along." His soft low voice was deep as the booming of the surf. "We need you both, very badly, and we have news which will disturb you." He nodded majestically at the dark archway. "Come and meet my associates."

Ironsmith was amiably shaking the big man's offered hand, commenting like a delighted tourist on the bleak grandeur of the spot. But Claypool stepped back warily—his narrowed eyes looking for a Triplanet agent.

"Hold on, here!" The fabric and the cut of White's threadbare, silver-colored cloak, he saw, belonged to an unfamiliar fashion, and White's soft accent was not quite native. "First thing—I want to see your papers, Mr. White."

"Sorry, Claypool." The big man shook his shaggy, flaming head. "But we're all traveling light. I have no papers."

Cold suspicion caught hold of him again, and Claypool shivered.

"You've got to have papers, Mr. White." His nervous voice came too thin and high. "You know that. Every citizen is required to carry a passport from the Security Police. If you're a foreigner—and I think you are—you aren't allowed off the spaceport without a visa."

White looked at him with intense, expressionless, bright-blue eyes.

"I'm not a citizen," that soft drawl came. "But I didn't arrive by ship."

"Then, how—"

Claypool caught his breath, and stepped backward dazedly. He looked down at the child. She was digging a small bright shell from her pocket. She presented it shyly to Ironsmith, and he accepted with a grave bow of thanks. Claypool thought him much too easy with these suspect individuals.

He blinked at the red-bearded man, demanding:

"How did that child get into Starmont?"

White made a low booming chuckle, and the little girl turned from Ironsmith to smile up at him with a shining adoration on her starved blue face.

"Dawn," he murmured, "has a remarkable accomplishment."

"See here, Mr. White!" A bewildered resentment sharpened Claypool's voice. "I don't like these queer hints—or your peculiar method of luring us out here. I want to know what you're up to."

"You are fenced in with red tape." White smiled at him gently, drawling that disarming explanation. "Dawn avoided it, to reach you in the only way we could. I assure you that we are not Triplanet agents—and we'll send you safely back before your men decide to open fire."

Startled, Claypool peered back toward the mainland. The gray official car beyond the yellow barrier was vague in the fog. He couldn't see the two men waiting behind it. Certainly he couldn't see their weapons.

"I call myself a philosopher." Beneath that deep, lazy voice, Claypool could hear a hard undertone of savage vehemence. "But that's only a tag—useful when the unsuspecting police of some doomed nation want to know my business—but not completely accurate."

"Just what is your business, Mr. White?"

"I'm a soldier, actually," murmured the giant. "I'm fighting a ruthless war, against a vicious, secret enemy. I arrived here quite alone, a few days ago, to gather my desperate little force for this final stand."

White gestured gently at the old stone tower.

"Here's my fortress," he boomed softly. "And here is my little army—three men and a brilliant child. We have our weapons, even if you don't see them. We are training for a bold assault—for only the utmost daring can hope to snatch the victory from our dark and overwhelming enemy. But now we have bad news."

The huge man paused, staring forebodingly into the mist.

"We've met reverses," he rumbled solemnly. "This brave little force is not enough, and our weapons are inadequate. Now it develops that we can't hope to win, without the help of one or two first-rank rhodomagnetic engineers."

Claypool shuddered to an icy dismay, for the whole science of rhodomagnetics was still classified top

secret. Even Ironsmith, whose computing section had established so much of the theory, had never been informed of its frightful applications. Trying to cover his consternation, he demanded bitterly:

"By what authority—?"

White's slow smile stopped him.

"My only authority is the fact that I have met this insidious enemy," the big man said. "Nations and planets have fallen, but I know the danger and I have found a weapon. I stand alone—unless you choose to join me."

"Don't talk riddles!" Claypool blinked, annoyed. "Who is this enemy, so-called?"

"You will meet them soon," White promised softly, "and I think you will call them so. They are ruthless and intelligent and nearly invincible—because they come in a guise of utmost benevolence. I'm going to tell you all about them, Claypool—I've a sad and dreadful warning for you. But first I want you to meet the rest of my bold little band."

He gestured urgently at the black archway. The little girl took Ironsmith's hand again, and the young mathematician went with her cheerfully into the darkness of the old tower. White stood aside, waiting for Claypool to follow.

Glancing uneasily at the big man, Claypool felt a tremor of awe. White moved with a light-footed, silent grace. Wide of shoulder and lean of hip, he looked to have a lazy, limitless, feline sort of strength. The set of his massive head and the glint of his hard blue eyes showed an equal power of purpose. A queer philosopher, Claypool thought, and a very singular soldier.

Reluctantly, Claypool entered the archway. The chill wind came after him. Shivering, he felt the closing of a trap. But the bait still drew him—the unaccountable riddle of that small girl, chattering now to Ironsmith about her handful of colored shells. The bearded giant stalked in behind him.

The tower room was round and vaulted, dimly lit from narrow slits of windows. The damp, crumbling stones of the massive walls were black with ancient smoke, scratched with the names of visiting vandals. Claypool blinked against the gloom, and saw three men.

They were squatting around a small open fire in the middle of the stone floor. One stirred a battered pot set on three black stones, and Claypool met a staggering reek of garlic. Ironsmith was sniffing appreciatively, and the three made room for him and the child to sit on driftwood blocks by the fire. The little girl leaned to warm her hands; and Ironsmith, ruddy in the firelight, smiled amiably at the three.

But Claypool had paused in the doorway, incredulous. He saw no weapons, and the three bold soldiers were only ragged vagrants, in need of soap and barbering. He frowned in uneasy annoyance as Ironsmith passed around a packet of chewing gum, but the three seemed innocent of Claypool's prejudice against that

common habit, and they helped themselves.

White presented his soldiers. The gaunt man stirring the pot was named Graystone. He rose stiffly, a gaunt and awkward scarecrow in rusty black. His angular face was stubbled and cadaverous. He had dark sunken eyes and a very red nose. He bowed with a solemn dignity.

"Graystone the Great." He amplified the introduction, in a hollow, rasping voice. "Formerly a noted stage magician and professional telepath. My act was quite successful until the untutored populace lost its interest in the treasures of the mind. We shall be honored if the two of you decide to join our noble cause."

Lucky Ford was a small man, bald as Claypool, crouching close behind the fire. He looked cold. His dark face was seamed and wizened, and darker pouches sagged under his narrow shrewd eyes. He squinted up at Claypool, and nodded silently.

"Ford was a professional gambler," White explained.

Claypool watched, fascinated. The little man had peeled the chewing gum and tossed the wrapper into the fire. Now, still watching the guests, he absently started rolling dice against a stick of drying driftwood. He didn't seem to notice what he was doing, but the dice always came sevens.

He met Claypool's astonishment with a thin-lipped grin.

"Telekinesis." His voice had a hard nasal twang. "Mr. White taught me the word, but I could always roll the bones."

The dice danced away from the driftwood, and made another seven. "The thing is not so profitable as you might expect," Ford added cynically. "Because every gambler has something of the skill—and calls it luck. When you win, the suckers always think you cheated. And the law ain't friendly. Mr. White got me out of a county jail."

Ash Overstreet was a short heavy man, who sat on a rock in stolid immobility. He looked sallow and unhealthy. His thick hair was prematurely white. Massive lenses seemed to magnify his dull, myopic eyes.

"A clairvoyant," White said. "Extratemporal."

"We used to call it just a nose for news, when I was in the newspaper game." Overstreet scarcely moved, and he spoke in a dull, hoarse whisper. "But I got to seeing too much, before Mr. White taught me to control the perception. That's why I started taking drugs. Mr. White found me locked up in a laughing academy."

Claypool shook his head uneasily. All such phenomena of the mind belonged to a disreputable borderland of science, where the truth was always obscured by superstition and trickery. Even in cases where the facts seemed above question, it was unfashionable to take them seriously.

Something made him look around for the little girl in yellow—and he

IRONSMITH

saw that her place was empty. He blinked at the fire, shivering uncomfortably. She had been there, he was certain, just a moment before, chattering to Ironsmith. But now she was certainly gone.

"Where—" he gasped blankly.

Ironsmith turned to the narrow doorway, watching with a calm bright interest, and the child came running in again. She handed Ironsmith some small metal object, and sat down again by the fire.

"Please, Mr. Graystone!" She watched the simmering stew, with enormous eager eyes. "I'm awful hungry."

"You've met Dawn Hall," the big man was drawling softly. "Her great accomplishement is teleportation."

"Tele— What?"

Claypool wrestled with an overwhelming surmise.

"I think you must agree she's pretty good." White smiled through the red beard, and the child looked back at him, her great eyes luminous with a mute admiration. "In fact, she has the richest psychophysical abilities that I've found on several planets."

"Dawn was another misfit," White told him. "In this age of machine-worshipers, her young genius had been ignored and denied. Her only recognition came from some petty criminal, who tried to make her a shoplifter. We took her out of a reform school."

Her thin blue face smiled up at Claypool.

"And Mr. White never has to beat me," she informed him proudly. "Now there aren't any iror windows, and I always have enough to eat. And Mr. White is teaching me psychophysics." She spoke the word with solemn care. "I went to find you in that cellar in the mountain, all by myself. Mr. White says I did very well."

"I . . . I think you did," Claypool stammered faintly.

The child turned happily back to Ironsmith, and went on chattering about her studies. Claypool peered about that smoke-blackened room, where a few driftwood timbers and little piles of straw made the only furniture. White saw his taut unease.

"A curious fortress, I know." That blue fire of ruthless purpose lit the huge man's eyes again. "But all our weapons are in our minds, and the pursuit of the enemy has left us no resources to waste on needless luxuries."

Dazedly, Claypool watched the absent little gambler roll another nervous seven. That must be a well-practiced trick, he thought, and the child's unaccountable appearance at Starmont must have been another. No respectable scientist would take serious stock in this paraphysical stuff.

He swung back to White, stiff with a skeptical hostility. But he tried to hide his bleak mistrust, and his doubt of Ironsmith, and his cold scorn for the dubious band about the fire. He must stall, study these people, discover the motives and the methods of their strange trickery.

"What enemy?" he rapped.

The red-maned giant smiled alarmingly.

"I see you aren't taking my warning very seriously." His rumbling drawl had taken on an ominous intensity. "But I think you will when you hear this bit of bad news."

And White took his arm, to draw him away from that motley group at the fire. He felt the big man's lazy, light-footed strength again. He saw the iron purpose in that angular red face, and heard the driving, fanatic power beneath the muffled boom of that deceptive voice, as White murmured gently:

"Mason Horn is going to land tonight."

Claypool swallowed hard, and tried to cover his shock. For these suspicious characters, whether desperate Triplanet agents or merely clever private rogues, had no right to know the name of Mason Horn.

V.

For the mission of Mason Horn was another high secret, as closely guarded as Project Thunderbolt. Three years ago, in the search dome at Starmont, a meter needle had trembled. A recording pen made a sharp little peak on a turning drum. And young Mason Horn quietly vanished from his job and his home and the knowledge of his friends.

"Automatic trackers of Project Lookout indicate a very singular neutrino burst at 14:17:03 today, Universal Time," Claypool stated in the urgent, secret report he encoded and dispatched to warn the Defense Authority. "Co-ordinates fall in Sector Vermillion—where Intelligence reports indicate current unexplained activity of Triplanet spacecraft.

"Anomalous characteristics of recorded curve convince me that observed burst is secondary effect of extremely penetrative gamma

radiation disrupting atoms in massive shielding. However, check with warning net shows that counters on satellite stations recorded no recent peak in gamma rays of indicated penetration.

"That discrepancy is ominous. Gamma rays can be successfully shielded, and neutrinos cannot. This observation, therefore, indicates carefully shielded test, in Sector Vermillion, of new Triplanet military device. I am afraid that this device makes obsolete all our defenses against fission weapons.

"Because gamma rays produced by atomic fission are inadequate to produce observed effect. Rays of indicated penetration are possible only from complete conversion of entire nuclear mass to energy. Triplanet possession of any such device is gravest threat imaginable to our national security. No defense is believed possible.

"Instrumental error at Project Lookout is unlikely. Careful recheck of instruments, records, and computations shows no alternative explanation. My considered judgment is that our planet faces extinction in event of hostilities. Investigation of Triplanet activities in Sector Vermillion urgently advised."

Young Mason Horn had been drafted from the Starmont staff, to make that investigation. In three years—since he boarded a Triplanet liner, booked as a salesman of medico-radiological supplies — no word of him had come back.

Now, in that smoky den, Claypool felt ill with shock.

"Mason Horn!" he gasped. "Did he find—"

Caution choked him, but White's great shaggy head had already nodded at Ash Overstreet. Turning slowly from the fire, the clairvoyant peered up vaguely through his heavy glasses. Bleached from confinement, his lax face had a look of heavy stupidity.

"Mason Horn made an able secret agent," he whispered hoarsely. "In fact, though he doesn't know it. Horn has well developed extra-sensory perceptions. He penetrated the arsenal of a Triplanet space fort stationed out in Sector Vermillion, and got away with a sample gadget. I don't quite understand the device, but I get his fear of it. His label for it is 'mass converter.'"

Claypool's legs turned weak. He looked around him blankly, and sat down on a driftwood block. For all those three ghastly years, perfecting those missiles of Project Thunderbolt and waiting beside them in the vault through eternal days and sleepless nights, this was the thing he had most greatly feared. He swallowed to wet his throat.

"So that's your bad news?"

But White gravely shook his flowing, fiery mane.

"No, our true enemy is something vaster and more vicious than the Triplanet Powers, and the weapon against us is something more deadly than any mass converter. It is pure benevolence."

Cold and numb, Claypool sat hunched on the driftwood block. His stomach tried to heave, from the damp smell of the old tower and

the garlic reek of the stew. His voice came faint and dry, protesting:

"I'm afraid you don't understand mass-conversion weapons. They use all the energy in the detonated matter—and the theoretical maximum for a plutonium bomb is not a tenth of one per cent. They make a different sort of war. A single mass detonation can split the crust of a planet, boil the seas and burn the land, and poison everything with radio isotopes for a thousand years."

He shuddered a little, staring at White.

"What could be worse than that?"

"Our benevolent enemy is."

Claypool waited, perched uncomfortably on the block, taut and silent. White came to sit on a straw bed before him, moving with a supple, feline vigor. A hard purpose and a shocking hate rang deep and ruthless under the gentle rumble of that slow drawl.

"Our enemy has spread out from Wing IV. The story is simple and dreadful. Ninety years ago, that planet faced the same crisis that this one does today—the old hard choice of slavery or destruction. But a man named Sledge created a third alternative."

The hushed power of White's voice held Claypool.

"Physical science had got out of hand there, as here. Sledge had already discovered rhodomagnetism on Wing IV—nearly a century ahead of you, Claypool, by absolute time, but two light-centuries away. He had seen it misused for a weapon. And he tried to bottle up the technological devil he had freed.

"Military mechanicals had already been evolved too far, on Wing IV. Sledge used his new science to build android mechanicals of a new type—humanoids, he called them—designed to restrain men from war. He was too successful. His rhodomagnetic mechanicals are a little too perfect."

The big man paused, taut with an angry energy.

"I knew Sledge." Beneath his lazy voice, Claypool could hear a savage ring of hate. "On a different planet. He was an old man, then, desperately fighting the benevolent monster he had made. A refugee from his own humanoids. For the mechanicals were following him from planet to planet, spreading out across the colonized section of the Galaxy to stamp out war—exactly as he had designed them to do.

"He couldn't stop them.

"He found me a homeless child, wandering in a land that war had ruined. He rescued me from famine and terror, and I grew up to join him in that hopeless crusade against his own creation. I worked with him for a good many years, while he was trying one weapon and another to stop the humanoids. He always failed.

"Sledge grew old, defeated. He tried to make a physical scientist of me, to carry on after him, and failed again—for I lacked his scientific gift. He had been a physicist, and I grew into something else. Living like a wild animal in the rubble of ruined cities, hunting and

hunted, I had learned powers of the human mind which Sledge could never recognize.

"Our philosophies came to differ. Sledge had put his faith in machines—and made the humanoids. When he came to see his blunder, he tried to destroy them with more machines. He was bound to fail—because those mechanicals are as nearly perfect as any machine will ever be.

"But I was groping for a better weapon. I put my trust in human beings—in the native human powers I had begun to learn. To save themselves, I saw that men must now discover and develop their own inborn capacities—crippled and neglected as they are from long neglect."

Staring out through the narrow archway beyond the fire, into gray drifting fog, the big man sighed. The broad shoulders under that worn, silver-colored cloak made a heavy little shrug, but that brooding purpose burned invincible in his eyes.

"So at last we separated. I'm sorry that our parting words were too bitter—I called him a machine-minded fool, and he said that my efforts would only end in mechanizing human beings, instead of setting them free. Sledge went on to try his last weapon—he hoped to ignite a chain reaction in the oceans and the rocks of Wing IV, with some kind of rhodomagnetic beam. I never saw him again, but I know he failed.

"Because the humanoid didn't stop."

White's blue, smoldering eyes drifted to his four followers. The gaunt awkward telepath, stirring the black pot. The pale clairvoyant, motionless and lax on his rock. The nervous little gambler, absently practicing telekinesis. And the eager-eyed child, clutching a cracked white bowl and chattering to Ironsmith while she waited for her stew.

"So I'm fighting Wing IV, and all those benevolent hordes of Sledge's humanoids," the huge man rumbled. "And these are my soldiers." A mighty indignation throbbed beneath his drawl. "Look at them—the most talented citizens of the planet! I found them in the gutter, the jail, the madhouse. But they are the last hope of man."

Claypool flinched from the angry booming of his great voice, and demanded uneasily: "I don't quite see . . . what are these weapons of the mind?"

"One is atomic probability."

"Eh?"

"Take an atom of Potassium-40." White's voice turned softly patient again. "As a physicist, you already know that such an unstable atom is a natural wheel of chance, set to pay off only once during several billion years of spinning. Like most machines of chance, it can be manipulated. In fact, being smaller, it is a good deal more responsive to telekinesis than, say, a pair of dice."

Claypool glanced uneasily at little Lucky Ford, crouching thin and withered over his dice, which now showed a five and a two in the firelight. He blinked unbelievingly.

"How do you manipulate an atom?"

White's blue eyes turned dark with trouble.

"I don't quite know," he rumbled heavily. "Although Dawn does it easily, and the rest of us have sometimes been successful—it seems that children learn the mental arts more easily, perhaps because they don't have to unlearn the false truths and break the bad habits of mechanistic science."

White's brooding face warmed for a moment, as he glanced at the child, who was eagerly watching old Graystone ladle out her bowl of stew.

"But I don't know." He shook his red mane, and sighed. "The facts I have discovered are often apparently contradictory, and always incomplete. Perhaps the physical principle of uncertainty involved in atomic instability doesn't apply to psychophysical phenomena. Perhaps it is merely illusion, arising from the fact that our physical senses are too coarse to perceive nuclear particles. I have suspected that physical time and physical space are also illusions, coming from our other physical limitations. There's too much that I don't know. But I do know that mental energy can detonate K-40 atoms."

The big shoulders shrugged wearily, in the silver cloak.

"I've had dreams, Claypool." White's slow voice seemed suddenly sad. "Dreams of a splendid coming era, when my new science of the mind could free every man from all the old shackles of the brute and the machine. I used to believe that I could conquer matter, master space, and rule time."

Heavily, he shook his bearded head.

"But I've failed, in all such large efforts—I don't know why. I run into blind alleys, and I stumble over obstacles that I don't expect. Perhaps there's some barrier I fail to see, some limiting natural law that I have never grasped."

The huge man sat for a moment, bleakly silent.

"I don't know," he rumbled bitterly. "And there's no time left for trial and error now, because those invading mechanicals are already upon us."

Claypool's thin jaw dropped, with a shocked unbelief.

"Yes, old Sledge's humanoids are already infiltrating your defenses," White assured him solemnly. "Those efficient machines, you see, make very superior secret agents. They are clever enough to avoid detection by any ordinary means. They don't sleep, and they don't blunder."

"Huh!" Claypool gulped, astonished. "You don't mean—mechanical spies!"

"You've met them," White drawled gently. "You would find it extremely difficult to distinguish them. But one thing I have learned—for all my failures at psychophysics—is how to tell machines from men."

Claypool gaped, unbelieving and yet appalled.

"They're already here," White insisted. "And Overstreet believes

that Mason Horn's report will be the signal for them to strike. So you see we've no more time for bungling. To stop them at all, we must grasp every device we can. That's why we need rhodomagnetic engineers."

Claypool peered, bewildered.

"I don't quite see—"

"These humanoid mechanicals are rhodomagnetic," White's driving voice cut in. "They are all operated by remote control, on rhodomagnetic beams, from a central relay grid on Wing IV. We must attack them through that grid—for the loss of one individual unit, or a billion, wouldn't hurt them. Now I've no head for math, and old Sledge failed to teach me rhodomagnetics. But we've got to have an engineer.

The bearded giant leaned forward, taut and urgent.

"So now will you join us, Claypool?"

Uncomfortably perched on his driftwood block, Claypool hesitated for half a second. He was fascinated by this glimpse of White's dubious disciples, and challenged by the possibility of an actual science of the mind behind their enigmatic gifts.

But he shook his head uneasily. If all this were true—if Mason Horn were really coming back, with proof that Triplanet scientists had perfected a working mass-conversion weapon—then he should be back at Starmont, standing by for the signal to launch those shining, terrible missiles of Project Thunderbolt.

"Sorry," he said stiffly. "But I can't."

Oddly, White didn't argue. Instead, as if he understood the reasons for Claypool's refusal, the big man nodded and turned immediately to Ironsmith, who sat talking with the old magician while the little girl sucked up her bowl of stew.

"Ironsmith," White rumbled softly, "will you stay?"

Watching, Claypool's eyes narrowed. If the young man did, that would go to prove that he was already involved with this queer group. He might even have helped old Graystone the Great stage an expert illusion of the little girl's visit—if such a thing could have been illusion.

But Ironsmith was shaking his calm sandy head.

"I can't see what's so terrible about those mechanicals," he protested amiably. "Not from anything you've said. If they can actually abolish war, I'd be glad to see them come."

White's intense blue eyes turned almost black.

"They're already here." Savagely harsh, his great voice forgot to drawl. "Overstreet says they know all about Mason Horn, and such a crisis of runaway technology is always the signal for them to strike. You'll both change your minds when you meet them."

Ironsmith met that lowering glare, with a pink and affable grin.

"Might be," he murmured, "but I don't think so."

The big man stiffened, as if stung

by Ironsmith's genial calm. Taut with impatience, he turned back to Claypool.

"Still there's one thing you can do, Claypool. You can warn the nation of those humanoid spies infiltrating your defenses, and those invading ships from Wing IV on the way. As adviser to the Defense Authority, you can perhaps delay the invasion long enough—"

White broke off suddenly, looking at Ash Overstreet. The short pale man had stirred a little on the rock where he sat. His dim eyes stared vacantly at nothing, but the tilt of his white head had a curious alertness. He didn't speak, but old Graystone turned quickly from his low-voiced talk with Ironsmith.

"It's time for you to go," rasped the red-nosed magician, "because your men are getting nervous. They imagine that we are Triplanet agents, and they're ready to blow us up. Armstrong is watching the time, and Dodge has his rocket-launcher sighted on the tower."

VI.

Claypool peered at his watch, and came gasping to his feet. He ran out of the dark tower room without ceremony, and stood frantically waving his hat, hoping that Armstrong and Dodge could see him through the wind-driven mist.

Behind him, Ironsmith took a more deliberate leave. He heard the easy, cheery murmur of the carefree mathematician, the hoarse alcoholic rasp of old Graystone, and White's soft drawl. Then Dawn Hall chuckled with pleasure, and he heard her treble piping:

"Oh, thank you, Mr. Ironsmith. I'm awful glad you came!"

Taut with his fear that Armstrong and Dodge might fire before they could see him in the fog, Claypool peered impatiently back through the smoke-stained archway. Ash Overstreet sat motionless, somehow alarmed, staring at nothing. Little Ford was huddled over his dice. White came surging to his feet, a queerly dynamic vagabond.

"Come along!" Claypool rapped. "Before they shoot!"

But Ironsmith didn't seem alarmed. He lingered maddeningly, to shake the trembling hand of the old magician, and murmur some farewell to White. He had turned out the pocket of his baggy slacks, to give the little girl a few coins and all his stock of chewing gum. She stood waving at him, solemn-eyed and tiny, when he came away at last.

Shuddering from a blast of the cold sea wind, Claypool turned with the younger man, and they left the tower. The gray car waiting on the mainland was dim in the fog. He kept desperately waving his hat, as they clambered hastily down the great wet stones of the broken causeway, until Ironsmith promised him easily:

"They won't shoot."

"How do you know?"

Grinning, Ironsmith showed him that dark bit of metal the child had brought. "The firing link, out of the launcher." Ironsmith chuckled. "Little Dawn is pretty clever."

They ran back along the wet narrow path, and up to the car. Claypool was breathless, and cold with sweat from something more than effort. He turned at the car, to peer back uneasily at the old round tower, high and dark in the driving fog.

"You had us worried, sir," Dodge called in grateful relief from his launcher in the ditch beyond. "That hour was nearly up, before we ever saw you."

In a flat, tight voice, Claypool told him to unload the launcher and test the mechanism. He obeyed—and shouted a startled curse. The firing link was missing. His jaw dropped when Ironsmith quietly gave it to him.

"Don't mind that now." Claypool clung to the door of the car, shivering in the mist. "Just stow your gear, and let's get back to Starmont. Because I think the project is going to be alerted—soon!"

Claypool didn't feel like driving. Armstrong took the wheel, and he sat with Ironsmith and the weapons behind, chilled, and stiff with fatigue, and vaguely ill from the motion of the car.

Uneasily, he studied Ironsmith. Sprawling lazily in the seat, with his feet propped unconcernedly on the launcher tube, the young man sat watching mountain and forest with a casual interest until they dropped back to the brown monotony of the desert. Then he stretched and closed his eyes and went to sleep.

Claypool sat taut with his own apprehensions, envying the peace of the smooth-faced sleeper. Mocking uncertainty tortured him, until he had to talk. He jogged Ironsmith's elbow, and the mathematician awoke instantly to a quiet alertness.

"I'm a physicist." Claypool was hoarse with worry. "I'm used to limiting my inquiries to phenomena that are reproducible at will, by mechanical means, under strict controls. This paraphysical stuff always upsets me."

"I remember." Ironsmith nodded cheerfully. "I recall a paper of yours, attacking the evidence for extrasensory action—pretty violently."

"Just a lab report," Claypool protested defensively. "You see, Ruth's firm had supplied equipment for some crackpot experiment—to control the fall of dice in a tilting frame. I felt that she was too serious about it, so I set up duplicate equipment and tried to repeat the experiment—just to show her that it was all nonsense. My results gave a curve of random distribution."

"Which was an excellent proof of extraphysical action!" Grinning quizzically at his startled gape, Ironsmith explained: "Because any sort of extraphysical research requires a slight modification in the methods of classical physics. The experimenter is also a part of the experiment, and your negative results are a logical outcome of your negative purpose."

Claypool stared, as if discovering a stranger. Ironsmith had never seemed much more than a con-

venient adjunct to the electronic calculators, serenely content with his little job. He had annoyed Claypool with his careless dress and his chewing gum and his cheerful lack of ambition. His friends were janitors and soldiers, waitresses and telephone operators. He had always showed an irritating irreverence for the established aristocracy of scholarship, and Claypool was startled into silence, now, by his unexpected cogency.

"Purpose is the key," he went on casually. "But White has too much of the wrong sort—he is looking for weapons, instead of the truth. That's why I think he'll never learn enough to beat these humanoids. He hates them too hard."

Claypool's eyes opened wider, and narrowed again. Resentment of Ironsmith's pleasant calm spurred him to a bitter-voiced protest:

"White has reasons. He knows these mechanicals, remember, and we don't. I intend making a full report of his warning, to the Defense Authority. Our military forces ought to be alerted against this invasion."

"I'd think that over, sir." Ironsmith shook his sandy head. "Because this whole affair would seem a little odd, you realize, to anybody who wasn't on the spot. Our own testimony wouldn't sound very impressive to a military commission."

His boyish face grinned brightly.

"Besides, I think these new mechanicals might turn out to be very useful. For all White said, I still can't see any real reason to hate them, or be afraid. I really hope they come."

That soft-voiced protest recalled the watchful doubt in Armstrong's eyes, when he first heard of the little girl's inexplicable visit. The members of the Defense Authority might prove equally incredulous. Claypool decided to wait for better evidence.

It was twilight when the car labored up the narrow road from the desert, to the guarded fences and flood-lit buildings on the mountaintop. Claypool felt cramped and groggy with fatigue. But Ironsmith jumped lightly out when they stopped at the gate, stepped easily on his cycle, and pedaled, whistling, down the gravel path toward the computing section.

The warning came at midnight, on the tight-beam printer.

VII.

The warning was a Red Alert—which meant two missiles ready against each of the Triplanet Powers, with pilot relays set and the staff of Project Thunderbolt standing by to press the buttons and end three worlds.

A second message, five minutes later, called Claypool himself to the capital for an emergency meeting of the Defense Authority. His official plane landed in cold rain at dawn on a military field. A waiting staff car took him into a guarded tunnel. Deep in the underground sites, he came at last into a narrow room of gray concrete.

Waiting for the meeting, he sat

hunched at the foot of a green-covered table, fighting a smothering claustrophobia. He hadn't been able to sleep on the plane, tossed with nocturnal thunderstorms along an occluded front, and the flight lunch he had shared with the crew felt heavy on his stomach. He needed a bath, and a dose of bicarbonate.

Clammy in his travel-wrinkled clothing, he sat longing for the dry warmth of Starmont, and trying not to think of anything else. The air blast from a droning fan numbed him with the chilly damp of underground spaces, and a faint reek of drying paint sharpened his dull illness.

He blinked and started when he saw Mason Horn. The secret agent came into that long gray room, between two armed lieutenants of the Security Police. Claypool rose eagerly and called out his greeting, but Horn made only a stiff little nod and one of the lieutenants beckoned Claypool to keep away. They stood watchfully apart, at the end of the room.

Horn carried a small brown leather case, chained to his left wrist. Claypool sank back into his chair, staring at that case with a kind of terror. He had tried to doubt White's warning, to question Overstreet's clairvoyant prophecy. But now he knew what that case must contain, and the knowledge was something close to madness.

One of the lieutenants saw him staring, and frowned at him sharply. He started again, and shifted his gaze, and tried to wipe the sticky moisture out of his palms. The midnight lunch began to burn his stomach, and he shuddered from the penetrating damp.

The high military and government leaders who formed the Defense Authority came in at last, surrounded with hushed, nervous little groups of their satellites. They took places at the long green table, and waited anxiously. The very silence felt heavy to Claypool, oppressive as the quarter mile of rock above.

The aged world president called out quavering greetings to a few of his cronies, and shuffled stiffly to his big chair at the head of the table. Stooped and trembling under his years and his burdens, he leaned on the arms of his solicitous military aide, one Major Steel.

This Steel was remarkably slight, even smaller than Claypool, dapper and crisply immaculate. When the president was seated, the little major came to rigid attention at his elbow, staring fixedly down the green table with sharp, unblinking eyes.

Claypool peered back uneasily, deeply troubled by the failing vigor of the president and his obvious dependence on the little officer. He recalled rumors of Steel's phenomenal memory and efficiency, but he had never liked the little aide. Steel, he felt, had gained an undue influence, which might be dangerous in this desperate crisis.

"Gentlemen, I've bad news for you."

The president's voice faltered thinly, and his emaciated face was

lax and gray. He called feebly for the report of Mason Horn.

The special agent left the two lieutenants, and stepped up briskly to the table. With thinning yellowish hair and a fat, red face, he looked more like a shoe salesman than an interplanetary spy. He unlocked the light chain, opened the brown case, and silently displayed a polished metal object the size of an egg.

"This is what I brought back." His abrupt voice had a dry nasal tone. "It came from a Triplanet arsenal in Sector Vermillion. The president has instructed me not to reveal the technical specifications of this device. I'm just to tell you what it can do."

The men around that long, bright-lit table, all of them withered with years and tight-faced with anxiety, leaned silently to watch. Horn's plump careful fingers unscrewed the flatended egg into two parts, and set them on the table. Cold light glinted from tiny screws and graduated scales.

"Huh!" The chief of staff made a kind of sniff. "Is that all?"

Horn gave him a brief, amiable smile.

"Actually, sir, the device is only a fuse. The charge is formed by any matter which happens to be near. This little screw sets the radius of detonation—anything from zero to twelve yards. The shielded tests they made three years ago in Sector Vermillion showed that the mass-energy conversion is ninety-seven per cent complete."

His flat voice stopped abruptly, and an appalled silence filled that buried room. Men stared with a sick, slack-jawed fascination at the device on the table. The muted drone of the ventilator fan became a roaring, and that thin paint odor brought Claypool a mounting surge of illness.

His mind was busy converting cubic yards of rock to tons, and tons of mass to the energy equivalent. The answer staggered him. He tried to tell himself that Project Thunderbolt was still a better weapon. Yet he knew that no mass weapon was better than another. For they were absolute. Any at all was good enough.

"One of these could finish us." With a fumbling care, Mason Horn began screwing the two small sections back together. "They can be placed in advance, and detonated by remote control, by a time fuse, or even by the penetrating radiation from a mass explosion on another planet."

He paused, carefully locking the chain again.

"The Triplanet Powers have now had almost three years to plant these where they want them," he added abruptly. "They may have been dropped into our seas, or sowed across the polar caps, or perhaps even smuggled into this site. No defense is possible."

"I don't see that." The chief of staff cleared his throat, with a kind of bark. "They must know by now that you got away with this, and they will expect us to duplicate it. It follows that they must fear retaliation in kind. They will scarcely

dare to strike—not since we know."

"I'm afraid that fear will rather increase our danger, sir," Horn protested flatly. "Because absolute weapons have their own explosive psychology, and I think the Triplanet Powers must now be near national hysteria. I think we should be prepared to die at any instant, sir."

And Horn stood silent, mopping apologetically at his plump red face. Scowling, the chief of staff sat down. These brash young men, with their unbelievable weapons and their cocky pronouncements, had destroyed all his pleasure in the ancient calling of war.

Claypool wiped his palms again. He saw the mute query on the bleak gray face of the defense minister, and he shook his head. Project Thunderbolt was ready, alerted. The war heads of those long, self-guided missiles had a forty-yard detonation radius. Once they were launched, nothing could save the enemy planets. But those same blasts would also trigger enemy detonators, planted here. Claypool wrestled with that nightmare dilemma, and found no answer.

He saw the old president turn anxiously to his aide, with some question in his watery eyes. Little Major Steel nodded briskly, and helped him to his feet. Clutching the edge of the green table with trembling yellow hands, he cleared his throat uncertainly.

"An unpleasant situation, gentlemen," he quavered laboriously. "It first appeared to offer us only the hard choice of war without hope, or peace without freedom. However—"

He paused gasping, and gulped the water the little major held for him.

"Major Steel, however, has revealed a third alternative—"

That phrase took Claypool's breath. He remembered a pale tattered man, squatting by a smoky fire and peering through thick lenses with a queer alertness. Something drummed in his ears, and the old president's high voice seemed far away.

"—revelation came as quite a shock to me, as you will understand." The president nodded his drawn, cadaverous head at the dapper little aide. "But I believe we can accept Major Steel's advice without question, because he has been my efficient right hand for twenty years."

He coughed, leaning weakly on the table, and the brisk little officer held the glass for him to drink again.

"Major Steel offers us escape from both destruction and escape." The old man beamed gratefully at the dapper little major. "Now I'm going to let him state the amazing facts, with only this one word of warning—he is not a human being."

Claypool knew that he should not have been surprised. White had tried to prepare him for this, and he had always mistrusted the superhuman energy and competence of the president's aide. Yet now, as he stared down the green table, something made him shudder. Something drew his breath away, and lifted fear-pimples on his skin.

"At your service, gentlemen." The human vocal quality was suddenly gone from Steel's voice, and it became a mellow silver drone. "Just a moment, if you please—because the need for this disguise has passed."

And he slipped out of his crisp uniform. He snapped contact lenses out of his eyes. He ripped at what had been his skin, and began peeling flesh-colored plastic from his limbs and his body in long spiral strips.

A chair fell, with a shocking crash. Claypool heard gasps of breath-taken wonder. He saw faces turning stiff and gray with something close to horror. That thin paint-reek brought him another wave of nausea. Yet there was nothing horrible about the thing which emerged from that discarded human mask.

Rather, it was beautiful.

The shape of it was nearly human, but very slim and graceful. Half a head shorter than Claypool, it was nude now, and sexless. The sleek skin of it was a shining black, sheened with changing lights of bronze and blue. A yellow brand gleamed on its breast:

HUMANOID

Serial No. M8-B3-ZZ

"To Serve and Obey, And Guard Men from Harm."

For a moment, beside the president's big chair, it stood quite still. Now its eyes were blank orbs of polished steel, and its high-cheeked face was fixed in a look of dark benignity. After the flashing felicity of its action, that stark immobility was somehow eerie. Rigid and blind, it yet seemed taut with alertness.

Its golden voice throbbed musically:

"Your present alarm is needless, gentlemen, because we never injure any man. The identity of Major Steel was created for your own benefit. It was necessary for us to observe the technological crisis developing here, so that our services might be offered in time."

The defense minister had risen, still gasping.

"Mr. President!" he protested shakily. "I fail to understand this strange display. But I must remind you that our party is pledged to

uphold the antimechanicals laws, to protect the working classes."

The president merely nodded, and the machine replied:

"We bring no want or suffering to laboring men. On the contrary, our only function is to promote human happiness in every manner possible. Once established, our services will remove all class distinctions, along with war and poverty and toil and pain and crime."

The chief of staff fumbled agitatedly with a pitcher and a glass.

"But it . . . it thinks!"

The bright steel eyes turned quickly to him.

"All our identical units are joined by tight rhodomagnetic beams to our central relay grid in Wing IV. Such units as the one before you are only the limbs and sense organs of that mechanical brain. We can think more rapidly and effectively than men, because rhodomagnetic impulses are timeless and our relay grid is a better mechanism than the human brain. Our knowledge embrances everything that happens on many thousand planets. But you may welcome us without fear, however, because we exist only to serve mankind."

The chief of staff swallowed hard, and overturned his glass and pitcher. Moving with a silent incredible agility, the mechanical righted them before the water had spilled.

"Quite remarkable!" The chief of staff strangled on a swallow of water, and turned red in the face, and sputtered at the dark humanoid, now still again. "But how—precisely how can you abolish war?"

That high melodious voice pealed back serenely:

"We are used to dealing with such technological breakdowns, and we have developed extremely efficient methods. Our agents on these planets began preparing for this crisis ten years ago. Our ships from Wing IV are now approaching, and the necessary arrangements to begin our services are very simple."

The military man seemed to wilt before the steel-eyed machine.

"Your spaceports and those of the Triplanet Powers must be opened immediately to our shipping," it purred serenely. "We shall proceed to establish our services without delay. Our advance agents can prevent human treachery. At an agreed future date, all weapons and military installations must be surrendered to us for safe disposal."

The chief of staff turned a choleric purple.

"Surrender?" The glass fell out of his agitated hand, and crashed on the floor. "Never!"

The mechanical stooped instantly to recover the fragments of the glass, and then stood motionless again, a black image of ultimate beneficence. The bleary eyes of the old president made an uncertain circuit of the table, and his tremulous voice asked for discussion.

Claypool was deaf to the wrangling which followed. His stomach burned, and he tried to swallow the sour taste of an injudicious pickle. He sat shivering in the damp chill blast of the fan, watching that dark machine, and debating what to do.

Once he caught his breath, to re-

port the matter of White and his warning to the whole Authority. But that wouldn't do, because security still must be maintained on Project Thunderbolt. Finally he passed a note to the president, asking for a word in private.

"Gentlemen," that sleek machine was droning, "the Triplanet Powers will view any delay with suspicion and alarm. They may try to use their matter detonators, unless we reach a prompt agreement."

But the president rose unsteadily, to recess the meeting. He called Claypool and the defense minister into his private office, and had them close the soundproof doors. Here was the new paint, a dismal yellow-gray. The ventilators were off, and the fume was suffocating. Claypool's stomach burned, and sticky sweat chilled him. Gray-faced and swaying, he reported White's warning.

"Mr. President," he finished, "I think we ought to keep these mechanicals out—at least until we know more about them. I might suggest, sir, that we fire a demonstration shot at some uninhabited satellite, and send a warning note to the Triplanet Powers."

The old president hesitated, fumbling his withered yellow hands irresolutely together, and Claypool knew that he longed for the competent advice of little Major Steel.

"I'm afraid of war," he whispered anxiously. "And I trust Steel—"

He gulped, and his dim eyes blinked indecisively.

"I think we should keep them out, sir, and stall for time," Claypool insisted. "You might appoint a commission, sir, to investigate these new mechanicals on some planet where they are already established."

"I don't know." The old man wrung his hands together. "Let's send for Steel."

"Just a moment, sir!" Claypool protested. "We must protect Project Thunderbolt—I think we're going to need it."

"I don't know what to do."

A secret message, brought in by an excited male secretary, ended that agony of indecision. The satellite stations reported a vast armada of unidentified spacecraft, approaching at tremendous velocities through Sector Xanthic. The president read it, and gasped fearfully:

"Steel said we shouldn't wait—and that must be the Triplanet fleet!"

"I think not, sir," Claypool protested. "With those detonators, the Triplanet Powers have no use for heavy spacecraft, and I believe Sector Xanthic lies toward Wing IV." He felt a shiver of dread. "I believe, sir, that this is the humanoid invasion!"

"Invasion?" The old man blinked, bewilderedly. "Then I'll have to send for Steel—"

"Wait, sir!" Claypool put in urgently. "We can still stop them, remember, with Project Thunderbolt. I suggest that you send them an ultimatum, sir. Stop them, until we know the truth."

"But I'm afraid—" The presi-

dent twisted his bloodless hands unhappily, and then peered dimly at Claypool. "If things go wrong—" he whispered sharply. "If Steel has lied to me—can your missiles reach Wing IV?"

"With certain modifications—yes, sir."

The old man chewed his parchment lips, in the torture of doubt. His washed-out eyes went longingly to the door, but at last he gasped impulsively:

"Then we'll keep your project. Tighten up security, and complete your modifications. Get three missiles set for Wing IV. Keep your crew alert to launch them—if things go wrong." He gulped uneasily. "But we won't need them. I trust Steel."

They returned to the green table in the outer room.

"—approaching spacecraft are our own," the little black machine was announcing serenely. "They have no hostile purpose, and they carry no weapons. They have come to bring our services to this planet, if you choose to let them land."

The Defense Authority, a few minutes later, voted to suspend the antimechanicals statutes and open the spaceports to the craft from Wing IV. Claypool hurried away, livid-faced and trembling, to look for a dose of bicarbonate.

VIII.

The efficient machine which had been Major Steel helped draft the articles of agreement, subject to a vote of the people after sixty days. At noon, with that same alert machine beside him, the old president stood tottering before a battery of news cameras to announce the coming of the humanoids.

Claypool had found his bicarbonate, and a hotel room. He had soaked out his aching fatigue in a hot tub, and napped for two hours, and awakened with his brooding apprehension gone. He was even hungry again. He called room service, and ate while he listened to the broadcast.

He had begun to feel a vast relief. The decision was made, and the might of Project Thunderbolt still intact. White's frantic warning began to seem remote and unreasonable now, and he felt something of Ironsmith's bright eagerness to see the new machines.

The humanoids began landing, that same afternoon.

Returning in a staff car to his official plane, Claypool had his driver pull off the road near the spaceport, so that he could watch. One ship from Wing IV was already down. The enormous interstellar vessel dwarfed the tall familiar interplanetary liners, which now stood humbly along the edges of the field, towed hastily out of the way.

"Well, sir!" the awed driver whispered. "Ain't it big!"

The vast concrete aprons were shattered and buckled under the weight of it, and the black hull towered so high that a tuft of cumulus was forming about its peak. Claypool watched giant valves lift open, and saw the new hordes of

humanoids start marching down to the broken concrete.

Tiny against the scale of their colossal craft, they were all identical, nude and neuter, quicker and sleeker than men, graceful and perfect and tireless. The sun glittered on their yellow brands. They spread out across the shattered apron, and kept on marching down, by the black thousands, innumerable.

Enormous hatches opened, high in that dark towering hull. Long booms thrust out. Cables lowered huge crates. Shining black mechanicals swarmed to open them, and began assembling larger machines. Something crawling like a queer saurian began scooping up the ruined apron and shaping the rubble into gray paving blocks the size of three-story buildings, which it neatly laid behind it.

Breathless with wonder, Claypool climbed out of the car. Gadgets had always fascinated him, and here were gadgets evolved and perfected beyond his maddest imagining. Here was a whole new technology in action. He began to feel the emotions of a small boy at a circus parade.

The first roving mechanicals came to the high steel fence around the spaceport, near where Claypool stood. They began cutting it down, swiftly slicing the heavy mesh with small tools that he couldn't see distinctly, and neatly piling the sections.

Swarming about the task, they reminded him of small black insects. They worked silently, never calling to one another—for they all were parts of the same machine, and each unit knew all that any of them did. Watching their teeming efficiency, he began to feel a vague impact of terror.

For they were too many. Glinting with bronze and frosty blue, their hard black bodies were too beautiful. They were too sure, too strong, too swift. White's warning seemed more convincing now. He was suddenly grateful for the president's decision to save Project Thunderbolt.

Shuddering, he got quickly back in the car.

"Drive on," he ordered huskily. "Fast!"

"Right, sir." The driver pulled back on the road. "The world sure changes," he commented sagely. "What won't they think of next!"

Back at Starmont, the modifications took three days. Living mostly on coffee and antacid capsules, Claypool rebuilt three slim missiles, with new drives and new relays. Wing IV spun all the way across the colonized section of the Galaxy, but these sleekly tapered shapes of death had their own terrible geometry and Wing IV was only a few seconds farther than the nearest planet.

When the third missile was ready, Claypool went to sleep in his overalls, on a cot at the launching station. The printer bell awoke him instantly—and he saw that the time was nine, next morning. The brief message, from the defense minister, warned him to have Starmont ready for inspection by the humanoids.

He checked the three modified

missiles again, and left them racked and ready. Back at the surface, he locked the elevator, closed a dummy fuse box over the controls, pushed a rug over the escape door in the floor, left his overalls on a hook, and walked out of an innocent cloakroom in the search building.

The visiting mechanical arrived on a military plane, accompanied by the inspector general of the satellite stations and his retinue. A staff car brought them up from the landing strip below the mountain.

"At your service, Dr. Claypool."

In the midst of stiff military uniforms, the slender silicone nakedness of the tiny humanoid had a curious incongruity, but that oddness was not amusing. Its air of kindly blind alertness was somehow disturbing, and Claypool started uncomfortably when it called his name.

"We have come to inspect Project Lookout." Its voice was a mellow golden horn. "Under the agreement, we are to patrol military installations, and prevent any offensive action until the ratification election. Then we shall remove all weapons."

"But the project isn't a weapon," Claypool protested hopefully. "It's only a warning device."

He couldn't tell what the humanoid thought—nothing ever changed that serene expression of slightly astonished paternal benevolence. But it went blandly ahead with a painstaking inspection of the building, the instruments, the records, and the staff.

The inscrutable machine seemed to take a particular interest in the neutrino trackers. It stared blindly at the big, squat tubes, with their red-glowing webs forever sweeping space. It studied the directional plotters, and the softly clucking counters. It made him dig the specifications out of a safe, and gently demanded the name and address of every person who had helped to build the tubes.

Claypool felt tired and annoyed. He hadn't slept enough, and he felt an uneasy flutter in his stomach. He tried to end the interview, but the suave little humanoid persisted in its sweet-voiced inquisition.

"Thank you, sir," it purred. "And who was the mathematician?"

"All the routine math we took to the computing section."

"Thank you, sir. And who is employed there?"

"A young chap named Ironsmith." Claypool's protesting voice rose, too sharply. "But he had nothing to do with the design. He never saw the tube, or even heard about it. He's just a mathematical hack."

"Thank you, sir," droned the urbane machine. "That ends the inspection—except that we must speak with Mr. Ironsmith."

Alarm stiffened Claypool.

"But Ironsmith isn't even connected with the project." Desperately, he tried to smooth the apprehension from his voice. "Besides, we haven't much more time today. I've already phoned my wife that we're all coming over for cocktails and dinner, and she'll expect us right away."

He didn't want the mechanical

to meet Ironsmith—certainly not alone. There were too many secrets that bright young man could have guessed. But the little machine didn't care for cocktails, and it insisted serenely on its privileges of inspection. Unwillingly he called the computing section, and Ironsmith came pedaling down to meet it at the gate.

Claypool spent an uneasy evening. His delicate stomach refused alcohol, and he felt too anxious to eat. He drank coffee to keep awake, smoked a cigar until it turned foul in his mouth, and listened to the military party's gloomy talk of professional unemployment.

It was midnight before the little machine came back from Ironsmith. Nervously, Claypool put the departing group aboard their plane, and hurried back to the rooms where Ironsmith lived, behind the computing section. The young mathematician let him in, with a look of shocked concern.

"What's the matter?" Claypool blinked confusedly, and Ironsmith said, "Why so grim and haggard?"

Claypool peered sharply around the room, but he found no evidence of Ironsmith's dealings with his mechanical guest. The few pieces of furniture were shabby and comfortable. An open book of Galactic history lay face down on a little table, beside a tobacco humidor and a bottle of good wine. Ironsmith himself, in unpressed slacks and open-collared shirt, looked guileless and friendly as the room.

"That mechanical!" Claypool muttered bleakly. "The thing was grilling me all day."

"Oh?" Ironsmith looked surprised. "I found it very interesting."

"What did it want with you?"

"Nothing much—just a look at the machines."

"But it stayed all evening." Claypool searched his open face. "What did it ask you?"

"I was asking." Ironsmith grinned, with a boyish pleasure. "You see, that brain on Wing IV knows all the math that men have ever learned, and it's quite a calculator. I happened to mention a tough little problem I've been playing around with, and we went on from there."

"And that's all?"

"That's all." Ironsmith's gray eyes held a limpid honesty. "And I don't see any reason for your alarm about them, or White's hatred. Their declared purpose is the welfare of mankind, and machines don't lie."

Claypool wasn't sure of that, and he felt less sure of Ironsmith. But the young man's armor of amiable innocence seemed impregnable, and Claypool was staggering with worry and fatigue. He gave up his troubled quest.

Walking back to his house and his wife, alone in the calm desert night, Claypool felt a sudden bitter envy of Ironsmith's carefree ease. The old cruel burden of Project Thunderbolt became intolerable. For one bleak moment, he wished that the inspecting humanoid had found the secret, and set him free.

But he stiffened his worn shoulders, instantly. For those long, graceful missiles in the buried vault were the last defense of the planet, now that the invading humanoids were swarming everywhere. No matter how serenely benevolent the invaders seemed, he dared not put his burden down.

IX.

Claypool was recalled to the capital, next day, to attend the last sessions of the Defense Authority, as the human government prepared to wind up its business.

The ratification election was sharply contested. Labor leaders feared technological unemployment, although these new machines promised shorter hours and more benefits than strikes had ever won. Religious organizations suspected that the knowledge and power of the humanoids would leave too little scope for any higher omnipotence, and bureaucrats were apprehensive of an unregimented society.

The humanoids, however, knew the art of politics. They opened offices in every ward and village, and their silver voices promised every man a palace. Every man would have his mechanical slaves, and luxury beyond the dreams of emperors. They promised paradise—admission free.

The election came, and only a few blind reactionaries voted to stay the trend of progress. The humanoids had come to stay. They promptly began dismantling military installations. Soldiers and spacemen went home. Claypool was delayed at the capital ten days longer, until the Defense Authority could complete its own liquidation.

"Your responsibilities are ended." So efficient machines informed the government. A solicitous humanoid placed a pen in the trembling fingers of the old president, and he obediently wrote out his resignation. Afterwards, when they were shaking hands, his dim eyes came uneasily to Claypool's face.

"I'm through," he whispered faintly. "Now it's up to you."

Claypool met his troubled gaze, and nodded silently. He understood that Project Thunderbolt rested on his own shoulders now. Yet, filing out of the executive mansion with the others, he shared their weary relief.

The monster he had unwittingly loosed, when he broke off his honeymoon to observe the Crater Supernova, was now safely chained again. He was free at last to go back to Starmont, to Ruth and the pure science he loved.

He had all but forgotten his disturbing visit to White, in that ruined tower by the sea. The red-bearded stranger, with his disreputable disciples and his dubious science, seemed to have no place in the bright new future the humanoids had promised.

The mechanicals had disposed of his old official plane—for all such primitive contraptions were now declared too dangerous for human use. Waiting for him, when a trim humanoid driver took him back to

the old airport, Claypool found a wonderful new machine.

A long, mirror-bright teardrop, the new vehicle was unmarred by any projecting airfoil or landing gear. Two quick humanoids helped him up through an oval door. From within, the smooth hull was darkly transparent. The flat deck covered all the mechanism, and there were no controls that he could see.

The door closed silently, untouched.

"How does that work?" he inquired.

"All these devices are operated by rhodomagnetic relays, which are protected from human reach," purred the thing beside him. "That is necessary to guard human beings from accidental harm."

A second humanoid glided to the end of the deck and stood rigid there, staring blindly ahead. It touched no visible controls, but some concealed relays must have started the hidden machinery. The little craft lifted silently.

The mechanical beside him unfolded a low couch, out of the deck, and asked respectfully if he wished to sit. But Claypool didn't feel like relaxing. A vague disquiet had already stained his elation. He asked more questions.

"The craft is powered by material energy," came that pure golden tone, "which is transmitted by rhodomagnetic beams from our generators on Wing IV. The thrust is created by a rhodomagnetic field drive."

"So? And what is the field equation?"

The reply cast a darker shadow on his hopes.

"We can't supply you with such information," hummed the black machine, "because men who enjoy our service have little need of knowledge, and science has often been used for purposes contrary to the Prime Directive."

Yet, for all his vague forebodings, Claypool enjoyed that flight. Far swifter than any aircraft, the rhodomagnetic vessel lifted through a milky veil of high cirro-stratus, and on into the ionosphere. The sky turned purple-black, and he could see the planet's lazy curve. Flattened mountains crawled beneath, and the scarlet-winged sun dropped back eastward. And suddenly they were landing on a broad new stage, at Starmont.

Starmont was changed.

New walls and towers rose everywhere, glowing under the desert sun in a riot of luminous pastels. He glimpsed broad new gardens already bursting into flamelike bloom, strange with imported plants he had never seen before.

The door of the craft had no handle that a man could work, but it was opened for him silently. The two attentive mechanicals helped him down, too carefully. He started eagerly across the new red pavement of the landing stage, and then he was halted by a sharp sense of disaster.

The exotic gardens and the colonnaded walks and the long bright-walled villa beyond didn't surprise him, for he knew that the swarming

machines had been rebuilding all the planet into a streamlined paradise. It was a moment before he could see just what was wrong.

A breath of hot, sickening sweetness struck him, a rank jungle scent from some more tropic world. In a deep sunken garden where the administration building had stood, he saw tall red stalks, crowned with queer, writhing buds. Next he missed the white concrete tower of the solar telescope, and then he stared at the blue-and-amber villa on the crown of the mountain.

"Where is it?" he gasped accusingly. "The big reflector?"

For that great telescope had cost most of his private fortune, and many years of toil. Searching the spectrum of the Crater Supernova, it had found the clue to rhodomagnetics. He had fondly planned to spend his last years with it, exploring the outer galaxies farther and farther toward the ultimate unknown. But it had stood where now that villa was.

The famous Starmont reflector was gone.

That realization stunned him. For one bright instant, he tried to hope that the humanoids had simply replaced the precious instrument with some compact new device, as wonderful as the silver teardrop behind him. But that golden voice throbbed softly:

"The observatory has been removed."

A dim dread came to overwhelm his first sharp anger, and his voice turned husky.

"Why?"

"The space was required for your new dwelling."

"I want it put back."

The tiny machine stood frozen and alert, staring past him with sightless metal orbs. Its narrow handsome face wore a perpetual benign surprise.

"That will be impossible, sir. Observatory equipment is far too dangerous for you to use. Human beings are too easily injured by heavy instruments, broken glass, electric currents, inflammable paper and film, or poisonous photographic solutions."

Claypool blinked with a bitter amazement.

"You've got to replace that telescope," he said hotly, "because I'm going on with my astrophysical research."

That blind, kind alertness didn't change.

"Scientific research is no longer necessary, sir. We have found on many planets that knowledge of any kind seldom makes men happy, and scientific knowledge is frequently used for destruction. Foolish men have even attempted to attack Wing IV, with illicit scientific devices."

Speechless, Claypool shuddered from a dark sudden terror.

"Sir, you must now forget your scientific interests." That droning, melodious voice was dreadful with its ruthless benevolence. "You must now look for your happiness in some less harmful activity. Perhaps you can develop an interest in some innocent intellectual activity, such as chess."

Claypool cursed, explosively. The small machine watched him silently. Struck with high lights of bronze and icy-blue, its black, high-cheeked face was set in serene solicitude. It didn't move, and a new fear struck the man. He gasped hoarsely:

"Where's my wife?"

In the last harassed months, he had found no time to visit Starmont. Until the telephone system was taken out of service, however, he had called Ruth nightly. He had told her that he wouldn't be so busy now, and asked her wistfully to plan them a new honeymoon. He shivered, now, to a shock of cold suspicion.

"She's here," that limpid golden voice assured him. "In the new toy room."

"Will you tell her I've come home?"

"We told her."

His uneasiness mounted. "What did she say?"

"She asked us who you are."

"Eh!" Terror took his breath. "Is . . . is she all right?"

"She is well now, sir. But she has been unhappy. We discovered her secret troubles only a few days ago, after she learned that you were coming back. The unit watching in her room at night observed her crying, when she should have been asleep."

"So?" A surge of puzzled fury knotted Claypool's stringy fists. "Ruth used to be happy enough—what have you done to her?"

"Our function under the Prime Directive is to cure the unhappiness of men, not to cause it," chimed the small machine. "We asked her the cause of her tears. She was afraid of growing old, she told us. She was crying for the loss of her beauty and her youth. And she seemed alarmed about something else."

Claypool stood swaying to a numbness of bewilderment.

"But she's not," he muttered. "She's not old!"

"By comparison with our own steel-and-plastic units, all human bodies are very fragile and ephemeral. Your wife has been afraid of age for many years, she told us. She was afraid to lose her loveliness, and afraid of your return."

"Ruth—" Claypool felt the sting of tears, and then he shouted incredulously: "I left her happy enough!"

"She said that she was happy, so long as she worked at the observatory," droned the tranquil humanoid. "She said she loved the work, because she did it for you. Now she has no work—but we have made her happy again."

"Take me to her!"

Breathlessly, Claypool followed the urbane machine across the red pavement, and along a covered walk beside that sunken garden. He hurried past those pink, writhing buds, because their rank scent stung his nostrils and made him sneeze.

Huge doors slid open soundlessly, beyond tall amber pillars, to let them into the dwelling. The place had a faint bitter odor of new synthetics. The walls were some satin-surfaced stuff which could be made luminous, his guide purred, in any

pattern of colors he might desire. Broad shallow niches along the lofty hall held tridimensional color views of the scenic wonders of many worlds, and these scenes, the humanoid whined, could be changed at his will.

But Claypool was growing impatient of wonders.

At the toy room door, a wave of heavy scent staggered him. It was Ruth's perfume—that thick musk called Sweet Delirium. Her usual hint of it made a clean, clear fragrance. But this was an overpowering reek which took his breath, even before he entered the room.

The toy room was huge and splendid. The walls were hung with softly glowing tapestries, which the mechanicals must have copied from some nursery book, luminous with simple figures of animals and children at play.

He found his wife seated on the warm, soft floor. She sat flat, with her legs straight out, in the posture of a small child. She must have drenched herself with that perfume, for the heavy sweetness of it seemed suffocating. A small dark machine stood watching her with a tireless blind attention. At first she didn't see him.

"Ruth!" Shock had dried up his voice, and his knees trembled. "Ruth—darling!"

She was building a tower out of soft, bright-hued plastic blocks. Her hands seemed very careful, yet strangely clumsy. She heard his husky voice, and turned to face him as she sat. And she laughed, softly, in that cloud of overwhelming sweetness.

Time troubled her no more. She looked as young as she had been when the hard blue light of the supernova shone down on them to end their honeymoon. Her fine skin was pink from lotions and massage. Her dark hair had been washed to a golden blond. Her brows were arched too thinly, her lips too crimson. She wore a sheer blue negligee that she once would have thought far too daring.

"Ruth—my dear!"

Her staring eyes were wide and strangely vacant. She was still holding one of the spongy blocks, with a child's clutching awkwardness, in both her red-nailed hands. She spoke to him at last, with a child's soft and solemn voice.

"Hello," she said. "Who are you?"

The black impact of terror struck Claypool dumb.

But she knew him. The soft block fell out of her hands, and bounded silently across the elastic floor. The humanoid moved instantly to pick it up and hand it back, but she ignored it. She sat staring, her dark eyes big with effort.

"You're Webb," she whispered at last.

Claypool started quickly toward her, holding his breath against that penetrating sweetness. The dim pathos of her altered voice blinded him with tears, and he trembled with a sudden stark hatred for the humanoid beside her.

"Dear Ruth!" he cried brokenly. "What have they done to you?"

Her staring eyes had slowly lit with a dim and wistful gladness, and now her red mouth quivered in a smile. Her round white arms reached out, in a gesture of childish eagerness. And then she must have sensed his fear.

"They don't hurt us," she lisped. "They're our frien's."

Claypool checked himself, for her movement toward him had overturned her tower of blocks. Her round baby-eyes saw the damage, and her red woman's mouth thrust out in a petulant baby-pout.

"Let us help you, Mrs. Claypool."

The deft little humanoid gathered up the fallen blocks, and she began building them up again. Her dark eyes turned grave once more, absorbed. Her scarlet mouth smiled wide with pleasure, and Claypool heard a happy baby-chuckle.

She had forgotten him.

. . . AND SEARCHING MIND

X.

Claypool's knees were weak, and he could scarcely see. He turned away from Ruth, and stumbled back into that splendid hall which was a gallery of windows on many worlds, and waited for the humanoid to close the sliding door. He caught a deep breath of unscented air, and whispered bitterly:

"What have you done to my wife?"

"We have merely made her happy," the machine droned cheerfully. "We have taken all her cares."

"And her memory!"

"Forgetfulness is the key to human happiness," whined the suave machine. "Our new drug, euphoride, has removed her fear of age, and it will also protect her from the effects of time. Euphoride stops all the corrosion of stress and effort, and it triples the brief life expectancy of human beings."

"Maybe!" Claypool blinked incredulously. "Did she ask for it."

"No request was necessary."

"I won't have it!" Claypool was cold and gasping with his anger. "I want you to restore her mind—if you can."

"Her mind is not injured," the machine assured him brightly. "The drug merely protects her from her memories and her fears. She has no need of memory now, for we can shield her from every want and harm and human folly."

"I won't allow it!" The man's voice was vehemently shrill. He was quivering with hot emotion, his stringy fists unconsciously clenched. "You've got to bring her back!"

Trembling antagonism swept him close to the black machine.

"We acted under the Prime Directive." Blind and motionless, the humanoid softly murmured its sweet reply. "We have removed her worries, and made her happy. If the situation distresses you too much, sir, then it may be necessary for you to take euphoride, also."

For an instant he was stunned. The words had echoed in his mind like silver music before he ever grasped their sense. Then a savage fury fell upon him. The bald egg-shape of that black plastic head was close before him, and his quivering fist already knotted. Spurred to unthinking madness, he struck at it.

That blank steel stare saw nothing, and the intent serenity of that narrow face reflected no emotion. But the oval head moved slightly. His whipping fist slipped past, and the reckless force of his lunge hurled him forward.

He tripped on the foot of the machine, and stumbled toward the glowing wall. He might have fallen, but the humanoid moved quickly to catch his arms and set him on his feet again. It glided back from him, and he stood gasping.

He was dismayed at its effortless, incredible agility, and frightened by the feel of limitless strength in its warm plastic hands. Blood drummed loud in his ears. Faintly, far away, he heard its mellow, silver voice:

"That is useless, sir. Many men have attacked us, and none has ever won. Human bodies are too weak, and human minds too slow."

Gulping convulsively, Claypool stumbled back from it. It stood darkly beautiful and calmly kind as ever, but all his wrath had chilled into shivering terror.

"I . . . I didn't mean to hit you!" he stammered desperately. "It was just . . . just the shock." He tried to get his breath, and flinched from a trailing hint of Sweet Delirium. "I know I'll soon be happy enough, and I don't need your drug."

The machine stood impassively serene.

"That decision is our responsibility, but we shall try to help you find happiness, without the aid of euphoride."

He trembled with unbelieving relief.

"Then you won't . . . won't punish me?"

"Our function is not to punish men, but merely to aid them."

Claypool stepped back again, voiceless with appalled speculation. The black and shining thing before him was utterly benign, and unspeakably dreadful. It was the science he had always loved, evolved to infinity. It was the ultimate machine, the final mechanical god—created too perfect by imperfect man. Claypool was numbed with an unholy dread, and he trembled in blasphemous rebellion.

For it had to be destroyed.

He shuddered in its awful presence, for no angry god of arbitrary wrath had ever been more terrible. The yellow-branded words on its breast mocked him with the humane promise of the Prime Directive. Its very benevolence gave it a baffling strength, but it had to be crushed.

Breathing too fast and too loud in the solemn hush of that long splendid hall, Claypool backed away again. A cold numbness slowed him. Again he caught that bitter synthetic reek, tinged with Sweet Delirium and suddenly suffocating. His stomach felt uneasy and he wanted to sit down.

"I'll be all right." He gave the watchful humanoid a sickly grin. "All I need is time to think."

That was it. He must think how to reach the old search building and make his way down to the secret vault of Project Thunderbolt. He must find a chance to press a button there, to launch a missile against Wing IV.

For the humanoids had to be stopped.

Trying to hide that sudden cold resolve, Claypool turned and walked uncertainly toward a shining niche. The machine followed, half a step behind his elbow, noiseless and inevitable as his shadow.

He glanced back at it, taut with a baffled fury. He wanted to crush and shatter that polished, proudly tilted oval head, but he made his narrowed eyes turn away. He tried to relax his jerking muscles, and stared into the niche.

The bright, tridimensional picture was a window on wide desolation. On a limitless waste of rippled red

sand, huge eroded boulders crouched like monstrous sleeping saurians of dark stone. But Claypool scarcely saw them, for his mind wrestled with closer terrors.

Now he understood that blazing savagery of hatred in the hard blue eyes of White. For he saw that the smothering benevolence of these machines would doom the whole race to a kind of passive, prenatal existence, to a dim gray hell where every value of life was suavely denied.

Now he shared White's fanatic purpose, and suddenly he saw the reason for White's warning. That had puzzled him, because the clairvoyant Overstreet must already have foreseen the coming of the humanoids. But the warning, he saw, had saved Project Thunderbolt—and now the time had come to use it.

He stared into the niche, trying to feign a casual interest in those tortured demons of black stone, sleeping. He tried to keep his face relaxed, tried to slow his noisy breathing, desperately tried to drive his mind to useful planning.

He saw that he must have help. Alone, there was little hope that he could reach the vault. He must have aid to plan some ruse, to shake off his keepers and stand them off until he could press a firing key. But who was left to help him?

Urgent questions burned in his brain, but he dared not ask them now—for the machine might read his desperate intent. He mopped his palms, and drew a longer breath, and carefully studied those dark shapes of twisted stone.

"Interesting view," he commented blankly.

"That is a world to which we came too late," whined the small machine. "Intelligence arose there half a million years ago, liberated energies which it failed to control, and so destroyed itself. Those dark pinnacles are the ruins of a city, whose builders died for want of the Prime Directive."

"That so?"

Claypool looked again, and now he could see the shape of fused and blackened walls, the bulk of crumbled towers. He tried in vain to imagine that vanished magnificence, before it was burned and shattered into dark desolation.

But that lost race had been lucky, he thought. For the unknown builders at least were cleanly dead—which was a good deal better, he felt bitterly, than being buried alive under the smothering burden of the Prime Directive.

He stood gazing past those tumbled, monstrous ruins, toward a dusty red horizon, seeing nothing. His eyes had narrowed with frantic speculation. He had to reach the old search building, and that hidden vault—and one false step might betray the last hope of man.

"I think I'll take a walk." He turned from the niche, carefully casual. "Just to look at all these improvements."

"We are at your service, sir."

"I don't want any service."

"But you must be accompanied, sir. Because our function is to

guard you from every harm, at every instant."

Claypool sidled away again. Cold illness tightened his stomach, and that bitter odor of the walls, touched with Ruth's perfume, caught his throat so that he could scarcely breathe. But he fought the terror in him, the mad urge to open flight or open battle—for they were the ways to oblivion.

"You appear uneasy, sir," purred the attentive machine. "Do you feel unwell?"

"No!" Struck with instant panic, he halted his slow retreat. "A little tired, perhaps. I only need to rest. I suppose there's a room for me?"

"Certainly, sir. In the east wing. This way, please."

He followed the gliding machine. Some unseen relay opened another sliding panel, to let them into a huge, high chamber. Shining murals showed dancing sun-browned figures of lean young men and flower-decked girls, and the little humanoid explained:

"Those are scenes of a village spring festival, in the barbaric age when the first colonists here had almost forgotten their civilization. Your wife helped us plan the building, before she took euphoride, and she selected the paintings for us to copy. She thought you would like them."

They were very nice, he stammered. The mention of Ruth filled his eyes with tears of angry pain, but he dared not show any such dangerous emotion. He blew his nose, and sat down wearily on an enormous easy-chair to whet the blade of his hatred.

"Where's all the staff?"

Trying to seem at ease, he took a cigar out of the engraved pocket case Ruth had given him on his last birthday, clipped the end with the tiny blade in the cover, and snapped the built-in lighter.

"I'd like to see— Now what's this?"

Astonishment sharpened his voice, for the small machine had snatched the cigar from his lips. It took the case, put out the light, and laid it on a little stand beyond his reach. He started up angrily, but the humanoid planted itself serenely before the stand.

"Sir, we cannot allow you to smoke." Its golden voice was honey-sweet. "Fire is far too dangerous in your hands, and the excessive use of tobacco has become injurious to your health."

He subsided bitterly, trying to swallow his fury. One cigar wasn't worth a scene—or the risk of oblivion. And those long missiles waiting in the vault, he told himself grimly, were a good deal more dangerous than fire.

"Perhaps I have been smoking too much," he admitted uneasily. "But I was asking about my old associates here—where are they?"

"The astronomers and their families all left Starmont when we closed the observatory. We have built new dwellings for them, wherever they chose to go."

"And the civilian technicians?" He tried to seem calm, but fear had dried his throat. "The six young

men at the old search project—what happened to them?"

The machine stared blindly, eternally kind.

"They appeared unhappy about leaving the project, and it was necessary for all of them to take euphoride. Now they have all forgotten the project, and they appear quite happy."

"I see." Claypool nodded bleakly. "So all the Starmont staff is gone?"

"Except one man, sir?"

"Eh?" He sat up straight. "Who is that?"

"One Mr. Ironsmith, sir." whined the tiny machine. "He says he is quite happy here, and there was no reason for him to leave."

Claypool felt a pang of puzzled disquiet.

"Young Ironsmith, eh?" The indolent young man in the computing section was not the ally he would have chosen, but he manufactured a feeble grin. "A good friend of mine. A charming fellow, and a brilliant mathematician!" He peered hopefully at the dark machine. "I'd like to see him, right away."

Surprisingly, the mechanical made no objection.

"If you wish, sir."

It opened the door again. Another identical machine came silently to join them in the hall. Gliding alertly at his elbows, they escorted him out of the villa, and along a covered walk through the newly landscaped grounds.

Everything seemed too precise. The lawns were all too level and neatly rectangular, the walks too painfully straight. Even the tall evergreens had been uprooted and replaced in stiff, forbidding rows.

Oddly, however, the irregular grove about the computing section had not been disturbed. The grassy hillock had not been leveled. Sheltered among the trees, the old building with its common wooden walls and familiar bright red shingles seemed queerly untouched.

And then he say a stranger thing.

Ironsmith came pedaling his cycle down the curving gravel path to meet them. That in itself was unaccountable—for a bicycle, as Claypool recalled from his own youth, can scratch and bruise its rider. But Ironsmith rode alone, with no mechanical to guard him.

More disturbing still, he was smoking that underslung briar. He rode with no hands on the handlebars—in shocking defiance of the Prime Directive—holding a lighter to the pipe. Claypool's two blind keepers must have been aware of the act, but they uttered no protest.

The cruel unfairness of that filled Claypool with a stunned resentment. He couldn't understand such discrimination, but he tried to stifle his envy. For here, apparently, was one free man—free to push that button in the vault.

"Glad to see you home, Claypool!"

That hail of welcome had a warm genial ring. Grinning happily, Ironsmith braked the cycle to a perilous stop, alighted safely, and

gave him a strong brown hand—too strong, it came to him abruptly.

He dropped the hand, and staggered back from the boyish-seeming mathematician, speechless with a shock of horror. He tried hard to school himself, but his stomach fluttered and his knees turned weak and clammy sweat burst out on his face. He knew that he would never dare ask for Ironsmith's help.

That warm handclasp had seemed too strong, and logic had struck him a cruel foul blow. If men were not allowed to go about alone, or to handle fire, or to use any dangerous machines, then the conclusions was terribly clear—Ironsmith was not a man.

Shivering, he remembered little Major Steel.

XI.

Claypool cowered back from that careless youthful figure, leaning so idly on the cycle. A clammy stiffness grasped him, and his stomach writhed and knotted. Dark fear surged against the chains of his control.

"Why—Claypool!" Ironsmith's pink and boyish face showed a friendly, shocked concern. His hushed voice seemed startled, and altogether human. "Are you ill?"

He reached out an anxious hand, and Claypool shrank from it, shuddering. Yet it appeared human enough. The fair skin showed a convincing pattern of pink sunburn and freckle and tan. The fine hairs looked bleached with sun. The nails needed trimming, and one was a little broken. It looked entirely human—yet how was he to tell?

He swallowed a frightened protest, and clutched desperately at reason. A mechanical in human guise, he assured himself, should be no more dreadful than the two dark guards that followed at his elbows. But reason couldn't thaw the prickling chill from his spine, or turn back the tide of icy terror.

His eyes narrowed, searching for a clue.

Frantically, he studied the old bicycle with its rusty frame and worn tires and chipped enamel. He surveyed the lank and vigorous form propped a little awkwardly against it, the sagging slacks and faded shirt and comfortable old shoes, the sandy hair and sunburned cheeks and the gray friendly eyes, wide and puzzled now.

He could see no useful hint.

"Just tell the humanoids, if you don't feel well," Ironsmith was urging warmly. "They know all the medicine that human doctors ever did, and more. Whatever is wrong, they'll know how to fix it."

Claypool fought the shudder which swept him.

He didn't want any medical aid from the mechanicals. He already knew their cure for all unhappiness, and he didn't want his memory blotted out with euphoride. He shrank from the two steel-eyed machines on the path behind him, and blinked again at Ironsmith

How could he possibly tell?

The other looked human enough, but looks meant nothing. The

shock of that scene at the capital struck him cold again, when little Major Steel had stunned the leaders of the nation by snapping out his contact lenses and peeling off his plastic human cloak.

An X ray might have solved the problem instantly, but Claypool was a guarded prisoner now, forbidden all such dangerous equipment. And that mechanical brain on far Wing IV had already proved its complete alertness and efficiency. Little Major Steel had never been suspected.

Claypool could see no answer, and the enormity of the problem staggered him. For the colorless hack in the computing section had been trusted to develop all the mathematical theory behind Project Thunderbolt itself. If Ironsmith were indeed a machine—

A sick numbness seized him, for everything fitted too well. The ruthless machine inside this plausible and pleasant-seeming mask must have come to spy on Starmont. Even the names had a frightening likeness now—Ironsmith and Steel!

A shuddering weakness came up through his legs, and he clutched for support at the rusty frame of Ironsmith's bicycle—for Project Thunderbolt, he thought, must have been betrayed. And Ironsmith, he remembered, had been with him at Dragonrock, and learned the plans of White. For an instant he trembled to his sick dread of that vast efficient brain on Wing IV—and then he saw the contradiction in his logic.

He saw that Ironsmith couldn't be a mechanical.

That knowledge warmed him with relief, and oddly it drained the little strength left in his knees. He clung weakly to the battered cycle, beaming at Ironsmith's pink, astonished face with a fatuous joy.

"I'm so glad!" he gasped. "For a moment, there, I was afraid—"

He checked himself sharply. For the two genuine mechanicals remained at his elbows, black and alert and forever benign. He dared not say what he had feared. But his shaken brain held on to the comforting fact—Ironsmith had to be a man.

No test of his own invention could have proved it. He could scarcely have hoped to win any game of wits, against that swift and infallible thinking machine on Wing IV. But he remembered that Ironsmith had been with him at Dragonrock.

That dispelled his terrors. White and his disciples, with their paraphysical perceptions, could distinguish disguised mechanicals. Yet they had asked Ironsmith to Dragonrock, and talked of their plans against Wing IV. That seemed proof enough of Ironsmith's humanity.

Claypool's relief came out, in weak thin laughter.

"I was afraid," he whispered again. "For a moment I thought they had given you euphoride." He managed to swallow his mirthless laughter. "I'm glad to see you still remember."

Strength came back to his wob-

bling knees, and he let go the bicycle frame.

"And I'm all right." He mopped hastily at the sweat on his face, hoping that the blind, impassive humanoids wouldn't perceive the quivering of his hands. "Just a little nervous and upset. I've been working pretty hard, you see, and Starmont seems so different."

Trying not to shiver, he glanced back at the crown of the mountain, where once had stood the proud high dome of his old observatory. He looked quickly away from the blue roofs and splendid amber columns of the new villa there.

"I'm going to be all right," he insisted desperately. "I'm just a little tired, and I need to get adjusted. I'm just a little nervous. They gave that drug to Ruth, you know." He couldn't keep a tiny shudder from his voice. "And she almost didn't know me."

The lean young mathematician was deliberately knocking the bowl of his pipe against the bicycle frame. His open face grinned at Claypool, brightly amiable. Claypool smiled feebly back, desperately glad that the other was indeed a man.

"No, you've nothing at all to worry about," Ironsmith agreed cheerily. "The humanoids are taking care of everything. All you have to do is rest. Just relax, and let them make you happy."

He seemed to feel no dread, himself, of euphoride.

"It's good to see you back at Starmont," he went on genially. "The hill seems pretty lonely now, with the staff all gone. Won't you come on to my rooms, and tell me how you like these new machines?"

Claypool was still afraid to say how much he didn't like the humanoids, but he accepted eagerly. For that dark moment of unutterable suspicion had left him feeling terribly alone. Now he had a desperate thirst for human company.

"Please," he whispered nervously. "I . . . I want to talk to you."

A feeble spark of hope had lit again, in the black confusion of his mind. Alone, he could see no possible way to elude the humanoids and reach that firing button in the vault. But Ironsmith was free!

"Come right along."

They walked up the path toward the old red-shingled building among the evergreens, Ironsmith pushing his cycle. Claypool was bitterly aware of the two mechanicals that kept at his heels. Sharply he watched the youthful man ahead, still warmly grateful for his lank humanity, yet aware of a mounting envy.

And Claypool wondered.

They came to the door. With a rising chagrin and discontent, Claypool saw that it still had the old brass knob, made for a man to work. Ironsmith leaned the cycle against the wall, and showed him in. He paused in the doorway, staring around him with a bitter bewilderment.

For the old, book-lined room was a comfortable oasis of casual human disorder, in the midst of all this sterile desert of ordered shining newness the humanoids had

brought. The ancient, shabby pieces of man-made furniture needed dusting. Tobacco crumbs were spilled on the floor. At the big desk, a slide rule lay across an untidy clutter of papers, as if Ironsmith had been at work.

But work, he thought, was outlawed now.

"Have a cigar?" Ironsmith opened a new silver humidor. "You know I could never afford to smoke them before, but now the humanoids bring me all I want. I think these are pretty good."

Claypool glanced resentfully at the two small machines, following always close behind him.

"Thanks," he muttered, "but they won't let me smoke."

"Too bad—but they know best."

Apologetically, Ironsmith closed the humidor, but the mellow fragrance from it had filled Claypool with a hungry craving. He sat down stiffly, and the two humanoids came soundlessly to stand behind his chair.

He wanted desperately to beg Ironsmith's aid, to help him smash Wing IV and set men free of this smothering dominion. But he couldn't speak of that. He didn't quite dare even to ask the secret of Ironsmith's apparent special freedom. Nodding at the cluttered desk, he began indirectly:

"Are you still working?"

Lazily, the younger man sprawled his awkward-seeming length into a big worn chair, beside a small table where chessmen were set up in an unfinished game.

"Not really working." His smooth face smiled pleasantly. "Just playing around with a few ideas, that I never had time for before. The humanoids do all the routine math—though they let me keep the old machines in the computing section, for work I want to do myself."

"How do you manage that?" Claypool gulped at a bitter lump of jealousy. "They tell me that research is too dangerous, and useful work no longer necessary."

"But thinking isn't outlawed," Ironsmith murmured gravely. "And I believe men need to think." He picked up the queen of the black chessmen, absently. "In the old world, we had no time. We were all too busy running machines—until better machines set us free."

"Free?" Claypool blinked bitterly at the sleek mechanicals behind him. "Free for what?"

Ironsmith regarded the black queen, soberly.

"To live, I believe," he said softly. "Take my own experience. I used to be a kind of human calculating machine. Now I have time to look for the real meaning of mathematics. I have time to follow ideas—"

His gray honest eyes were looking far beyond the black queen, and his low voice trailed away. Claypool watched him sharply, wondering, until suddenly he sat up and replaced the queen on the board.

"I'm sorry, but I've another engagement now." Ironsmith adjusted two or three pieces, in the unfinished game, and then looked up with a sympathetic smile. "But

I'm sure you'll be all right, Claypool. Just trust the humanoids. Remember their Prime Directive—*To Serve and Obey, and Guard Men from Harm.* They can't hurt anybody."

Rising reluctantly, Claypool shrank away from the two silent things behind him.

"It's just that drug." Shuddering dread broke harshly into his voice. "I can't stand the thought of that. It's—murder!" He gulped convulsively. "That's what it is—murder of the mind!"

"You're overwrought." Ironsmith shook his sandy head, with a cheery calm assurance. "Really, for those who fail to find their happiness in any other way, I think euphoride is a very fortunate solution."

Claypool stood shivering, speechless.

"But you can avoid it, if you like," Ironsmith told him gravely. "All you have to do is accept the humanoids, and build yourself a new way of life that fits the Prime Directive. They have had to close the physical frontiers, I know, but you can find a wider field of research still open, in the mind."

Claypool merely stared, bewildered.

"I've an appointment, now." Ironsmith glanced down at the waiting chessmen. "But I'd like to help you get adjusted to the humanoids—really, they've opened a whole new world to science. I want to help you like them. Suppose we meet again, for dinner?"

Claypool nodded bleakly.

But Ironsmith would never be an ally—that was starkly clear. He had always liked the humanoids too well. Human beyond doubt, he still had turned against humanity. What price, Claypool wondered bitterly, had he paid for his special freedom?

Pondering that dark riddle, Claypool began to wish that the other had turned out to be a disguised mechanical, after all. That would have been a simple, clear solution. But the unknown truth behind Ironsmith's pink and genial grin seemed darker and more ominous to him now than any humanoid.

"Till dinner, then." Ironsmith murmured affably. "We'll go down to the coast—the mechanicals have built a new place for me there, but so many things have happened that I've never found the time to move." He nodded cheerfully at the shabby old room behind him. "Anyhow, I'm pretty well contented here."

Graciously, Ironsmith held the door. Claypool drove himself out. He glanced back uneasily, past the two blind benign machines, at the waiting chessmen. Clammy-fingered dread touched his spine again.

Who, he wondered, was Ironsmith's chess opponent?

TO BE CONTINUED.

THE INCREDIBLE INVASION

BY GEORGE O. SMITH

Illustrated by Ayers

It's very difficult to find a good, sound, legal way of stopping an aggressor—when the victims always anxiously invite him to come in and take over!

Jim Franklen paused a moment before he opened the door of the office. He stopped to read the black lettering with a surface of pride—he was a part of it.

The sign read:

UNITED NATIONS WEAPON SECURITY COUNCIL

Thomas Winter, President

Then Franklen opened the door and went in, confidently. He greeted the man behind the desk, who looked up worriedly from a maze of paper work and bade Franklen to sit down.

Winter said: "Trouble, Franklen. Bad trouble."

Franklen nodded. "I know," he said. "I've been following it. I

gather that the fools are getting worse?"

Winter agreed with a slight nod of the head and replied: "I can't imagine what they're up to. Yet they continue to rattle the saber and make demands. The Central Power is not ignorant of the ramifications of their acts. Not after we've made point-blank statements. But they continue to get rougher and bolder, just as though they had the world in the palm of their hands."

"They know that they can't win, don't they?" asked Franklen.

"They should—they've been told, and they have been shown exactly what will happen, how, and why. The proof is irrevocable, undeniable. Still they continue."

"I understand we've been watching them closely."

Winter smiled bitterly. "I've got so many men watching their separation plants and their atomic stockpile that even the janitors must find UN Representatives looking up out of their coffee cups in the morning. There's no activity there that can be construed as dangerous, even admitting that we're leaning way over backwards and would be suspicious of a single gram of missing fissionable matter. Of course, they have the standard United Nations stockpile; the safety value that all nations hold against possible aggression. They're also aware that this quantity is also a fraction of what the rest hold all together."

Franklen looked at the big flag on the back wall of the office. "The United Nations," he said bitterly. "With one member slightly dis-united." He turned back to the president of the Weapon Council. "Have they, by any chance, made secret pacts with other nations?"

"Not that we can tell," said Winter. "Now don't say that this is negative evidence and therefore inconclusive. It is admittedly negative evidence, but so definitely negative that it is conclusive. The Central Power has been told that if they make a move, they'll be counter-attacked within the hour."

Franklen paused in his walking and said: "Look, sir, there's one thing about the atomic weapon that is seldom considered. I've been thinking about this for a long time. Frankly, the atomic weapon is a fine instrument for any country to use—providing it has no intention of invading for territorial aggrandization."

"What do you mean?"

"Cities are where they are because it is economically sound that they should be there. New York is the largest city in North America only because it is situated on the one spot where most goods funnel out of the country. It grew because of that fact—the fact did not follow the city's growth. In all the world, perhaps Washington, D. C., is the only city that is where it is because someone said 'we shall place our city here!' and Washington could function very well if it were lifted in toto and dropped on the center of Ohio, providing it landed on some big railroad junction. Boston is a second rate city despite all the efforts of the city planners only because its harbor is less efficient

than New York's harbor and because Boston is not handily located geographically for the rest of the country. Even though Boston is closer to Europe than New York, it is cheaper to ship the goods a little farther by water, for they've got to be transshipped anyway, somewhere. For inland cities, both Detroit and Chicago are great because of their location; if their locations were not good, Chicago might still be a little tank town called Fort Dearborn, situated on the South Bank of the Chicago River—which would still be emptying into Lake Michigan."

"Granted, but what are you getting at?" asked Winter.

"Mankind has dropped two bombs in anger so far," said Franklen. "Both were dropped at the close of a war, to end it. Japan was not invaded for aggrandization. Therefore, no Americans were required to enter Hiroshima and try to rebuild it. We don't care too much whether Nagasaki ever gets rebuilt, though it will, eventually, because of the necessity of having a city right there."

"Yes, go on."

"The next time we have atomic trouble," said Franklen, "it'll not be exploded high in the air. It's more likely to emerge right out of the walls of one of those buildings. That will mean radioactivity in the area that will render it dangerous to life for some time. In any case, a totally destroyed New York is not an economic asset."

"Yes?"

"And the Central Power knows that we will not use the atomic weapons until they are used in aggression."

"No, you're wrong," said Winter. "We have promised them—and everybody—that at the first outbreak of hostility, the United Nations Weapon Council will see to it that one of their cities is reduced each day until the aggression ceases and reparations are made." He banged a hand into his fist. "It's a harsh promise, my boy, but it must be. For a border fist fight leads to knives, and knives lead to resolvers, and they lead to rifles, which lead to artillery. The next step in the scene is the works, complete and whole."

Franklen shook his head. "The first step is words," he said positively. "Then come the fists. We should let 'em have a sample on the first angry words."

"Can't. It's entirely possible that a party can be so nasty and quiet that steps are necessary on the part of the other. The truth must be investigated."

"Is that what's been happening?" asked Jim Franklen.

"At first it looked so," said Winter. "They started by upping tariffs and getting too rigorous with people coming in. They were told, and they replied that their country was at present overcrowded. Why, Jim, the entire pattern is familiar. They've been holding elections and all the trimmings for years, now, and every election they hold brings more territory into their hands."

"That's something that can't be

easily judged," admitted Franklen grudgingly.

"No, it can't; you're right. In any election there are plenty of unsatified people. We assume that the Central Power is padding the elections, but we cannot be sure. Well, again they have overrun most of Europe and now they're looking outward. We've got to do something, Jim. But we've got to be absolutely right before we move. That's what makes being right so hard, sometimes. He who is wrong can move without conscience. Well, it's now being tossed into your hands. See what you can do, take a carte blanche and see what you can find out."

Franklen nodded glumly. "I know what you mean," he said. "I'd hate to be the cause of fifty thousand killed, unless I was dead certain that my actions would save a million later."

Winter shook the younger man's hand. "Well, you've been brought into it," he said, "and you're trained to handle hypothetical problems of this nature anyway. So, my boy, go out and stop that incipient war for me!"

Jim Franklen remembered that ringing order many times in the following days. "Go out and stop that war!" was his order, and he was hoping he could. There was little real saber-rattling, but only a slow spread of the Central Power's influence that was conducted in a quiet fashion.

He read the previous reports several times, and analyzed them carefully. There was one more thing, a direct, personal, man-to-man warning that could be tried and must be tried before he moved. This act must also be publicized so that his following moves would be greeted with the proper attitude. The public must know that his course met with their approval.

This brought him to the government of the Central Power, where he was first stopped by an undersecretary.

"You may state your business," said the underling with all the authority of bureaucracy.

"I'm special representative of the United Nations Weapon Council," said Franklen, "and request audience with your state head, the Commissario Hohmann."

"You may state your business to me," said the underling.

"I'll state it to Hohmann himself," snapped Franklen quickly. "And he'll right well see me, too!"

"I'll inquire," said the undersecretary.

"You'd better."

"You understand that the Commissario speaks personally only with officials of his own rank."

"That's rank enough," grunted Franklen. "And I can be just as rank as he is. Now stop caging and make that appointment for me—no later than tomorrow morning! Rank? Spinach! Where I come from, we elect our rulers and they'd better do as we want them to, or they don't stay rulers! And Hohmann can put you in his pipe and smoke it! Or," he added softly, "shall I order a cordon of United

Nations marines out to see that I am properly escorted into his presence?"

"That would create an international incident," replied the undersecretary.

"Uh-huh," snorted Franklen. "It sure would, wouldn't it?"

Both he and the underling knew at that point just who would be deemed responsible for the international incident, and so there was no point in further argument. The phone was used three times, and ultimately it was reported that James Franklen would be most welcome in the morning at eight-thirty —and would he partake of breakfast with Commissario Hohmann?

He nodded. After all, Hohmann might not spoil his digestion— Franklen had a stomach installed by a copper company and felt safe.

There was pomp and ceremony as Franklen entered the swanky apartments of the Commissario Hohmann. He was escorted in by an honor-guard, and once in the ornate dining room, Franklen came face to face with the commissario himself.

Hohmann bowed genially and Franklen returned the pleasantry. He was seated across a small table from the dictator of the Central Power, and as he settled in the chair, silver service with a half grapefruit came from a servitor for each man simultaneously. Hohmann tasted his, smiled and nodded at it. "Excellent," he said to Franklen. Jim tried his and was forced to agree.

"Now," said Hohmann easily, "I've been told that the United Nations do not approve of certain happenings?"

"We do not," said Franklen. "We do not intend to interfere with the usual run of events, but we dislike to see the same pattern coming up again."

"Pattern?" asked Hohmann in surprise. His spoon paused in midflight as surprise caught him unawares, but then it continued on, upwards.

Franklen nodded, and then swallowed. "The pattern should be familiar," he said. "Small districts lying between larger countries suddenly vote alliance with your Central Power. A couple of years pass, and another district still farther out allies itself with you. Commissario Hohmann, your Central Power has increased its geographic size by a factor of two to one during the past five years."

"That I know—and I am also gratified to know that my government has something to offer these outlying districts."

"The trouble is," said Franklen pointedly, "that all of these districts have—or had—a system of voting that lends itself very well to a long-term carpetbagging system. The residence required before voting in the maximum case is one year."

"You accuse me of padding ballot boxes?" demanded Hohmann angrily.

"Not at all," said Franklen. "Padding a ballet box is illegal, which you would not condone. No, Commissario Hohmann, you are pro-

ceeding quite legally, but you are, nevertheless, twisting the law to suit your needs."

"Nonsense!"

"We know differently. There was the Phalz District that voted into your Power two years ago. It's voting population rose markedly for two years before the election, and dropped shortly afterwards. Strangely, its drop coincided with the rise of voting population in the Rhehl District a year later."

"You approach me with the accusation that people of mine are traveling from district to district and voting them into my government for them—and against their wishes?" demanded Hohmann.

"I wouldn't state whether it was the same people that moved," said Franklen, "but there is definitely some exchange."

"My dear young fellow," said Hohmann consolingly, "please do not be alarmed by some of the problems of the floating population of Central Europe. That is what happens when cities are decentralized, you know. And may I remind you that the United Nations were instrumental in decentralizing the cities of my country some twenty years ago?"

"You have all the rationalization of the last ruler of Central Europe. He proceeded legally at first."

"He proceeded legally until he was forced to move illegally. He was attacked first, you know."

"Look, Hohmann, he who eludes the legal statement by twisting the law to suit his own illegal end is illegal."

"That's sophistry."

"No, it is not. It is a statement of the fact that you are legally right and morally wrong and you know it. Frankly, you are expanding at a rate that will bring on a state of war and you know it. Regardless of

your spoken intent, you are expanding illegally and it must cease!"

"And I assure you that if people decide to join my government, I can but be gratified and accept them."

"Even though the populace disagrees?"

"They voted, didn't they?" asked Hohmann. And seeing Jim Franklen's answer, even though skeptical, Hohmann added: "And if they want to, they can as easily vote out again."

"Oh certainly," snorted Franklen angrily. "The district of one quarter of a million people vote in all by themselves, but in voting out again they must submit to a national election. One quarter million versus some seventy million."

"Well, the welfare of my country is a national problem, and the welfare of any part of it is equally a national concern. To secede, any part, therefore, should convince the entire nation that this course is best. That is, naturally, very difficult."

"Impossible," snapped Franklen.

"Almost impossible," agreed Hohmann, nodding his head slowly in complete agreement. "Yet for all your distrust of my government and its supposed aggressive attitude, I assure you that we are humanitarian to the core, and will go to any lengths to make our people happy. Unlike the former ruler, who insisted that the individual is second to the State, I know that the State is the property of the individual. Unfortunately—or fortunately—there are always differences of opinion. That makes it difficult to please everybody with any single act. We try, however, to make the bulk of the people satisfied. I—"

He was interrupted by the arrival of an aide, who brought him a sheet of teletyped copy. "Commissario Hohmann," said the aide, "I am sorry to disturb your breakfast, but this is an important message."

"Quite all right, Jenks," smiled Hohmann. "Pardon me?" he asked of Franklen. Then he read, first quietly and then aloud:

"International News Service representatives in Paris, France, today told of a serious pandemic sweeping the country. This illness seems to be some strange combination of mild dysentery complicated with very mild influenza. It is quite contagious; isolated cases were first noted three days ago, but the epidemic has been spreading into dangerous proportions. It is believed that if this pandemic gets worse, the government may close all places of business and public works."

When he finished, Hohmann looked up across the table at Jim Franklen. "Unfortunate," he said sincerely. "Yet one man's meat is another man's poison. This distressing affair may give me a chance to prove to you that the Central Power is still a member of the United Nations, and concerned about the common lot of all mankind."

"Meaning?" asked Franklen.

"Meaning that I must leave you for a bit. I intend to muster all forces that the Central Power owns that can, in any way, be used to combat the common enemy that is

striking at France. I invite you officially to join and observe."

"I may take that invitation," said Jim.

"The Central Power will enter that plague area to take relief and aid—even though we may ourselves suffer greatly. It is things like this, James Franklen, that endears us to our immediate neighbors. You may watch one half of the population of my country turn from their own problems, and bravely enter France to aid the stricken. Jenks! A message to Le Presidente Jaques La Croix. 'We stand ready to aid in every way if your need increases. You have but to request, and we will answer in the name of humanity! Signed Edvard Hohmann, Commissario of the Central Power.'"

Jim Franklen faced Winter wearily in the latter's office. It was two weeks later, and Jim was glad to be back, even though his mission was but half accomplished.

"I don't know how to stop him," he told the president of the Weapon Council. "He's like a stock market operator that doles out quarters to the beggar on the corner and then enters the Curb to squeeze some small operator out of his life savings. It is admitted —almost—that he is running a carpetbagging program over there. Then comes this plague in France. Like a first-class humanitarian, he musters his forces and they go into that area and take control for two solid weeks while practically every person in France is flat on his back with this devil's disease. It would have been easy for him to take over, Winter. But he sent in doctors and aides, and the like, and the only armed men he sent were merely small-arm troops. He sent just barely enough of them to maintain order, which they did and no more. I doubt if there was a store-window broken or a bottle of milk stolen over and above any normal interval. Then as the people of France recovered, he gracefully turned everything back, gave them a written report on his actions, apologized for whatever minor expenses his aid might have cost—his men did live off of the country, and that costs, you know —and then marched out with the bands playing and the people cheering.

"It gives me to wonder," continued Franklen. "Remember the 'Union—Now' cries between the United States and Great Britain during the last fracas? Well, solidarity between France and the Central Power was never so great before. Hohmann could ask them for the moon, and they'd present him with a gold tablet, suitably engraved, giving him clear and unrestricted title. Watch for a first-class alliance, Winter."

Winter nodded. "I've been watching," he said. "Regardless of how he does it, and he is a supreme opportunist, it is oppression."

Franklen grunted. "Even anarchy is oppression for some classes of people."

"But you and I both know that

he rode into his office initially on a program of oppressing the minority groups. He's made no great mass-murder of them as his predecessor did, nor has he collected them in concentration camps. Yet they are oppressed, for they have little free life. They are permitted to work only as their superiors dictate, and for a subsistence wage. They do the rough jobs; they work in Hohmann's separation plants, do the mining, and the dirty work. Each is given a card entitling him to secure employment in certain lines. All of these lines are poorly paid and quite dangerous or dirty. The wage is so low that the children are forced to forgo schooling in order to help pay for the family. Regardless of his outward act of humanitarianism, Hohmann is none the less a tyrant with ideas of aggrandization. That he is able to take a catastrophe and turn it into a blessing for himself is deplorable, but it seems to be one of those unfair tricks of fate to favor the ill-minded, for some unknown reason. I never knew a stinker that didn't get everything his own way for far too long for the other's comfort. Eventually, of course, the deal evens out, but the waiting is often maddeningly long."

"And we sit here helpless," growled Franklen, "all clutching our atomic weapons that could wipe out Hohmann and most of his country. And as we hang on to them, and rub their rounded noses angrily, we watch Hohmann walk in and take over—we are unsure of our grounds. Bah! Why not claim it for what it is—aggressive acquisition of territory? Then let's bomb him and let the world judge for itself."

Winter shook his head slowly. "And if we do, La Belle Francaise will rise up and scream 'Oppression'! For France is probably an operating country today because of Edvard Hohmann. There was once a first-class criminal, Public Enemy Number One, who, during a period of economic depression, used some of his ill-gotten gains to set up soup kitchens for the underfed. You'd hardly convince any one of them that he was entirely worthy of the electric chair and not much better. That was when his crimes were known to all. And people said: 'O.K., so he's killed a bunch of people. They were all criminals, too, and so he saved the country some expense. And besides, he set up soup kitchens, and so he's not a bad sort of fellow!' No, Jim, we've got to get evidence of definite acts of belligerency."

"Sort of like trying to get evidence against a confidence-man who sells his victims something that they believe valuable."

Winter nodded at the simile.

"More like a druggist who sells opiates indiscriminately. The people who buy them do so because they find them useful even though they are dangerous in the long run. But you keep on trying, Jim. The rest of us will see to it that Hohmann isn't running himself up a stockpile of atomics all the time

that his underground warfare is going on."

Jim Franklen left the office and wandered down the hall to the Chief Physician's office. Shield greeted Franklen cheerfully and asked what was on the younger man's mind.

"Nothing much," said Jim. "I was just wondering if you'd isolated the bug or whatever it was that hit France."

"We believe so," said Dr. Shield. "We'll know in another couple of weeks. It seems to be some sort of filterable virus, air-borne for contagion, and very rugged. Intelligent, too. It apparently knows enough not to touch diparasulfathiazole."

"How do these rare illnesses get going?" questioned Jim.

"In several ways. The Law of Simple Reactions also applies, you know." And seeing the blank look on Franklen's face, he added: "When a number of reactions are possible, the one that requires the least energy will happen first. That's saying that the most likely will happen first. A few hundred years ago, so many people died of typhoid, yellow fever, and smallpox that a more complex disease like meningitis or polio seldom got beyond the normal case frequency. When the more prevalent—the more likely diseases—were stopped, we could have polio plagues. It's probably been here for a long time, killing its quota every year, but never noticed because of other, more devastating affairs."

"I think I understand."

"Why did you ask?" asked the doctor.

"Well, I was there, you know. It was rather devastating, though it didn't kill off very many."

"It isn't that type," said Shield. "Which is another factor in its not being noticed. The early symptoms are dysentery, not violent, but definitely weakening. The secondary symptoms are similar to influenza in a mild form. The whole thing just takes all the energy out of the system and leaves you weaker than a kitten for about twenty days. After which you can get up and go again, though somewhat rockily. It's a one-shot affair, luckily. The body builds up an immunity to the bug, and once you go through with it, you're safe from then on—though upon re-exposure, you can act as a carrier."

"O.K., doctor. I was just wondering because I was rather close to it."

"You didn't catch it?"

"Nope. Not yet, anyway."

"And you were in the plague area?" demanded Dr. Shield.

"For several days with Commissario Hohmann."

"Then I'd like a sample of your blood," said the doctor, reaching for his sterile cabinet. "Maybe you are carrying the normal antibody in quantity already. I'd like to check it."

Franklen bared his arm and the doctor extracted thirty or forty CC of Jim's venous blood. "Thanks," said Dr. Shield. "We'll also see if

you have any other bugs running around loose in here," he smiled, holding up the vial.

"O.K., doctor," returned Franklen. "And if you do, just drop 'em a shot or something to pacify 'em until I get back and can take care of 'em again."

They parted on a laugh. And once outside of the doctor's door, Jim Franklen was met by an official messenger.

It was a personally written note from Edvard Hohmann:

Dear Mr. Franklen:

This is informal, because I believe that formality between friends is both stuffy and unreal. Also I count you among my friends despite the fact that our political beliefs differ.

However, in an effort to convince you of my sincerity, I am inviting you to be present as a guest of my party when the Central Power meets the French Chamber of Deputies. This will occur on August 8th, which is but a week hence.

It is to be an auspicious occasion, this meeting. Plans and forms have been drawn up, a compromise between the democratic government of France and the autocratic Central Power. We shall show the world and humanity that a meeting of mind is always possible between men of high purpose. True, both France and the Central Power must part with certain factors, but we both believe that departing slightly from our previous course by will and agreement is far better than going on as we have, and ultimately arriving at antipodal types of rule.

Will you attend? Will you come, even to scoff? For you will remain to wonder, and the approval of your Council will mean much to all of us. Be a witness to History in the Making!

Sincerely,
Edvard Hohmann,
Your friend and Commissario
of the Central Power.

He stared at the letter, wondering. Hohmann's actions seemed logical enough; doubtless if he, Jim Franklen, were in Hohmann's shoes, he'd accept whatever the fates offered and reject whatever trouble he could. Hohmann's ambitions were normal for any ruler of Central Europe, and he was not, at least, killing millions. Yet—

Franklen smacked his fist into the palm of his hand. He turned into Winter's office again and said: "I've got it!"

Winter looked up, wondering.

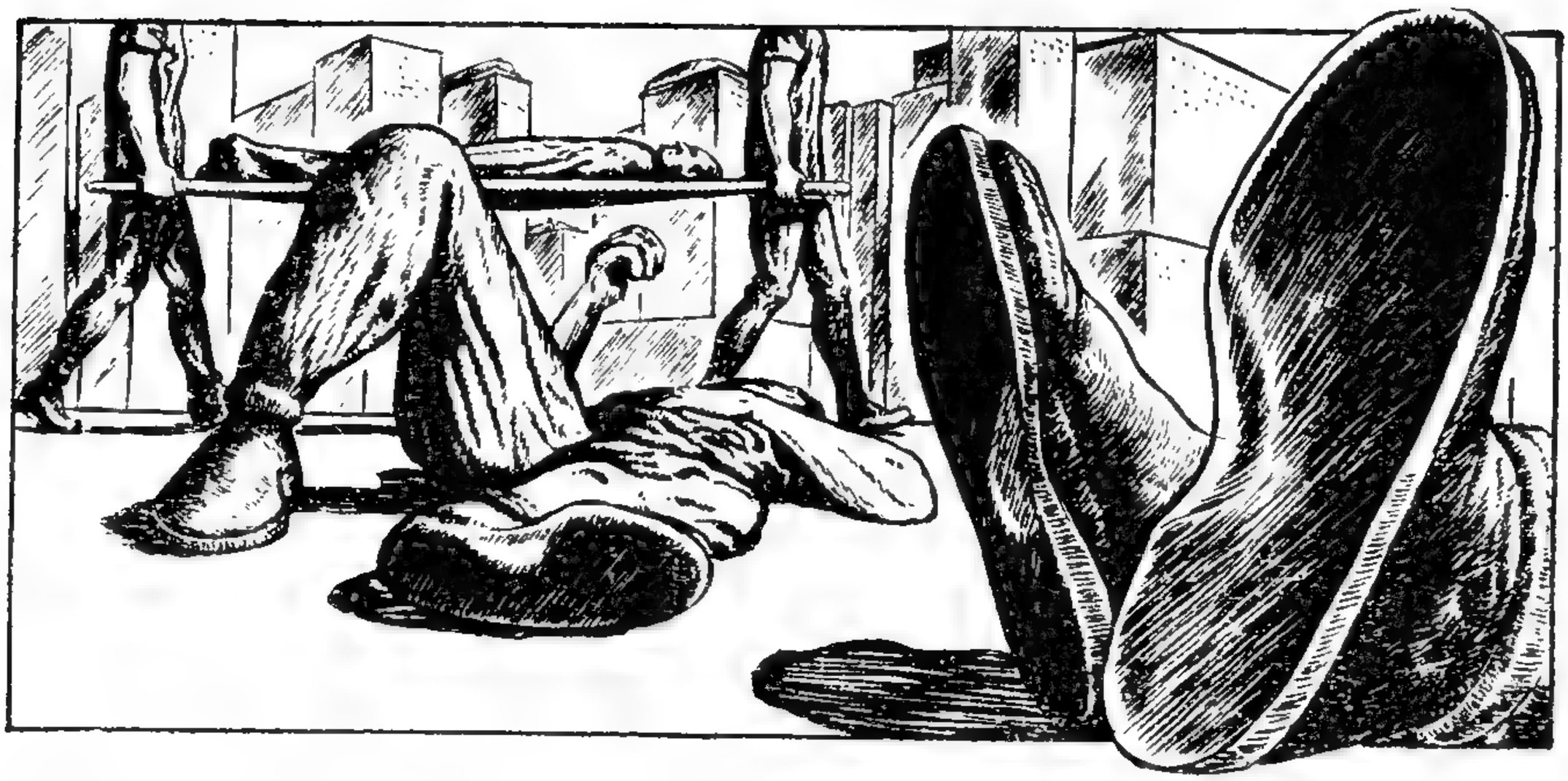
"Hohmann is using biological warfare," said Franklen. "It's logical, it's sensible, and it gets him what he wants, intact. He's soon to be running France, and not a shot has been fired nor a building damaged. Were he to strike an unfriendly country—or when he makes his final break, Hohmann can take over without resistance. No soldier can serve a weapon when he's prostrate with that combination of dysentery and influenza."

"But biological warfare is not considered practical."

"No?" snorted Franklen. "Well, if used properly, it can be better than atomics. Why blast a city you hope to add to your list? Why bother? You have to rebuild it. But if you just move in, you're in and you can use the same paper and pencils and desks and even the same clerks."

"May I point out the difficulty of proving such a thing?" asked Winter.

"In the first place, Dr. Shield told me that the ailment was a



single-time illness. Your own troops can have it in a mild form before the invasion. Thereafter they are immune. But they are also vicious carriers, and while they're working among the stricken people, they're spreading it among those few who haven't caught it yet."

Winter sighed deeply. "Yes, and even better for Hohmann is the fact that we can prove nothing. You can make enough germ culture in an apartment house to innoculate a city—contrasting, the separation plants of the atomic era. And, Franklen, can you or anybody else make Hohmann admit that his latest acquisitions happened by any other means than an Act of God? A pandemic is considered such."

"I'll get the proof," said Franklen.

"Just stop Hohmann," said Winter. "Then we can all rest!"

Franklen never went to Hohmann's great historic meeting. Three days before it opened, the same plague struck Mexico, and the United States sent its doctors and its nurses and its aids to the stricken neighbor. A good many of them came down with it themselves, but just as it had run in France, it ran itself out in three long, hot, Mexican weeks. American wealth was poured in, and American effort and American efficiency, and Mexico rallied and was grateful. Franklen was a busy man, during those days, and he spent another week in the area after the plague was stopped and the populace well on the road to recovery.

Then he returned to his office, to see Thomas Winter.

"Warfare — or happenstance?" asked Winter.

"I'll never know," said Franklen wearily. "Why would they—Winter! You know something!"

Winter nodded slowly. He handed Franklen a teletyped page, which Franklen read aloud:

"The State of Sonora, Mexico, today voted to secede from Mexico

in favor of joining the United States by a vote of almost three to one. If this is accepted, Sonora would become the fifty-first State of the Union. There is some doubt—"

"Winter—what is this?"

"A fragment of the International News Service report," replied Winter. "And here is a text of President Halstead's reply:

"The United States of America feels gratified that she is deemed so high by the residents of Sonora, Mexico. An act of this sort, however, must be made with the full consent of the Mexican Government."

"So we've got ourselves a Border Incident?" muttered Franklen.

Winter shook his head. "Worse than that. Here's the topper-offer," and he handed Franklen a sheet of paper. Franklen read it silently and then whistled explosively.

"So the Government of Mexico offers complete annexation of all the states of Mexico to the United States of America in exchange for certain provisos and considerations in the way of civil government of the new territory?"

Winter nodded. "And from what they tell me of the Mexican demands, the United States would be imbecilic not to accede to their request."

Franklen shook his head widely and slowly. "Madness!" he said quietly. "If we do, we're legally guilty of the same offense as Hohmann. If we do not, we're fools. How can the pot call the kettle black and still retain a moral sense of values?"

"Can't," grumbled Winter. "And we've got ourselves another twenty million citizens, three quarters of a million square miles, and something like a total of eighty United States of America!"

Winter stood up, his face bitter. "United Nations Weapon Council," he growled. "Preserve the future peace. Stop aggression and territorial expansion. Hell!"

He picked up a brass inkwell and hurled it through the door glass. His secretary peered in, wondering.

That was only the beginning. Just the start of a long series of similar events that came crowding in on one another so fast that it made one's head spin. Five years passed in this same mad whirl. Five years of the same crazy pattern.

And then the Central Power, which was now calling itself the European Power, faced the United States of The Americas across the Atlantic Ocean. From Ellsmere Island to Cape Horn lay the United States of The Americas, and from Spitzbergen to the Cape of Good Hope lay the European Power, all and both combined.

And as before, Jim Franklen, now an older but still struggling Franklen, was still working on the same question; and Thomas Winter, also older and more resigned, urged Franklen on.

"Hindsight," said Franklen sourly, "is infinitely superior to

foresight, or at least it is better accomplished."

Winter nodded. "This is what we might have expected," he said. "Years and years ago when Hohmann started this last war. Now we're all in a position where strife might well break out at any moment. And the question is whether to break out in open strife at once, or wait it out and hope for the best. We can no longer move leisurely. Hohmann has seen to it that for every advance he has made, we've made a greater one. But now he is fresh out of available land to spread out across, and he's looking at us. We've been dragged and dragged by his indirectness into this situation, where the United States as it was is no longer just we folks, but encompasses a myriad of peoples, types, and governmental ideas. True, Washington is still the seat of government, but that makes it seem as though we were to blame for our own expansion."

"I may be able to help," said Franklen at last. "I think I've got the answer, finally."

He said no more about it, but he was gone, somewhere for three months, after which he returned long enough to pick up Dr. Shield and fly with him to Europe. He gained audience with Edvard Hohmann within a few hours.

"My American friend," exclaimed Hohmann, taking Franklen's hand. "And this?"

"This is Dr. Shield," said Jim. "He's been instrumental in tracking down some of the many plagues that have hit the world."

"Perhaps he can tell us where so many different illnesses come from," said Hohmann, interestedly. "A kind Providence, that offers both myself and your government the chance to become great—it is kind, and I say right that we have prospered—seldom seems in existence at the proper time."

"Sometimes illnesses emerge from the common welter of human frailties only because they have been eclipsed by more common ailments," said Shield. "There is one other way in which an illness can suddenly break out. Mutations. If you recall, the photographic industry nearly went out of business when atomic power came in, because there were radioactive atoms everywhere—even in the emulsions and the films themselves. That has been largely abated, but only by special methods. The world, right now, is bathed in many many more kinds of radiation than ever before. Where once only alpha particles were, now are protons and neutrons and both positive and negative electrons, and gamma from here to there in wave length. Illness comes from bugs, Commissario Hohmann, and bugs as well as humans can evolve. The possibilities are limitless, it requires only a diligent search—"

"Diligent search?" asked Hohmann. "You sound as though you believed that someone might have been seeking such illnesses."

"Only academically, perhaps, just as we are," replied Shield. "Just to

know what possible mutations might take place, and perhaps give us a bit of warning, we have been operating a radiation-biological laboratory."

"Indeed?" said Hohmann.

"Oh yes. And we've come up with some of the most peculiar cultures. Pure laws of chance, because most mutants die. We've got a violent one that affects the calcium exchange in the body—your bones, you know, are in a constant state of equilibrium, the matter changes, new comes in to replace old going out—so that only the outgoing side is working. The bones jellify. We've licked that one by antibodies and partial immunities. But the more recent ones have rather peculiar effects. One of them strikes the nerves in the semicircular canals of the ear. During the two months of its run, the patient cannot stand, or cannot retain any balance at all. He cannot even lift his hands as he desires, because he . . . well, he might think he was standing on his head, but he can't even accept a delusion as to his position, for all position-sense is gone, completely. After two months, the average body recovers, and the patient is well again. We've feared that, and we've learned how to prevent it. That's a good thing, too, for it strikes within a few minutes after exposure to any carrier."

"A rather terrible possibility," smiled Hohmann. "I've always been proud of my sense of balance." He laughed nervously and stood upon one foot for a few seconds.

"We were thinking that it might be well to combine our laboratories," said Franklen. "We can pool our findings and collectively advance so that this wave of mutated bugs can be prevented."

"That is an excellent idea," said Hohmann—

At which point he fell flat on his face!

The world's stockpiles of atomic weapons is rusting and unused—as such. Gradually, they are being broken down and the high-grade fissionables are being taken and used to light the fires of humanity. Jim Franklen is an old man, no longer an agent of the United Nations, but just a citizen of United Terra.

And the rattle of the saber is gone, and the storm of atomic bombs is no longer expected.

For the last Global War was fought with weapons that seldom killed, never maimed, and always left the cities of the world intact for the next generation.

THE END.

WEST WIND

BY MURRAY LEINSTER

It would be impossible for a small nation to stop the armed might of a Great Power, practically futile to release atomic bombs against the bigger nation's cities. But there are ways—

Illustrated by Pat Davis

Igor lay in a ditch while the search for him came to an inconclusive end. This was an age of science and atomic energy, but the soldiers blundered through crackling brush with the clumsiness of spear-armed troopers of five thousand years before. They did not find him. It was pitch-dark, with thick cloud masses filling the sky, though here and there thinner spaces showed through which the moon and some of the brighter stars appeared faintly. Presently they gave up the search. A whistle shrilled, over by the truck, and he heard the soldiers stumbling toward it. The truck's headlights came on, and they were the only—absolutely the only—lights in all the world except the fugitive faint gleams in the sky. And the cloud-banks were piling up.

There was a plane circling in the darkness overhead. It had been seeking him with an infrared scan-

ner, and picking up only the systematically moving figures of the men who hunted him. Igor was hidden from the sky by the thick foliage of a tree which overhung his ditch. Now the plane droned away to the westward. It had given up the hunt, too. The soldiers converged upon the waiting truck. Igor heard their voices. Somebody shouted: *"Stefan! Stefan!"* A voice answered, faraway. It called again, moving toward the truck. Someone laughed, by the waiting vehicle. Some men climbed in. Igor heard their heavy boots on the floorboards. He began to make phrases in his own mind:

"I heard the men who were hunting me laugh, because one of their number had salvaged some left-behind trifle from a deserted farmhouse! They laughed in the moment of the most monstrous disgrace in the history of their nation! They could laugh as they, the last armed men, left the land abandoned to an enemy without a blow struck or received—"

The motor of the truck started up. The last man seemed to be running, not to be left behind. He swung aboard. The motor ground into first gear, and second, and third. The truck rumbled and growled away westward toward what was to be the new frontier. Igor was left alone.

He climbed out of the ditch and saw the faint bright fingers of light which were the truck's headlights flickering and jerking in the distance. He even saw, momentarily, the red taillight. Then the truck went over a low hill and was gone. But for minutes afterward he could still hear its faint and dwindling noise.

He suddenly felt a little sickish at his stomach. Those men, those soldiers in the truck, were his countrymen. He'd hidden from them out of patriotism, and they'd gone on. Now they'd keep traveling until they caught up with the last wave of evacuation patrols—thirty miles away by now—and merge with them, and by morning they'd have reached the new frontier. Igor was the only living human being left in a good many thousand square miles. He felt abandoned. Even the patriotism of his current errand wasn't comfort—but there was no comfort in patriotism, anyhow. It had made him become a political antagonist of the President of the Council of Ministers, though the President's niece Elsa had looked kindly on him and he'd had hopes of her love. Naturally, those hopes were gone, now. He'd had to choose between hope of winning Elsa, and hope of serving his country without reward. He'd chosen, but there was no joy in it.

He moved in a solitude greater than that of any marooned or shipwrecked sailor. Even the sound of the truck had ended. He came upon a stone fence. He knew that if he followed it he would come to a gateway and to an empty house. A deserted house, all its furniture and utensils remaining, but drawers open and ransacked, and all the precious personal possessions of its

owners gone. The stables would be emptied. There wouldn't even be a dog.

He trudged toward the highroad. The night was warm and balmy, with a soft and sentimental west wind blowing. The feel of it on his cheek made him think irrelevantly of the old nursery-rhyme that had been taught him by his nurse:

"The west wind, the west wind,
It's soft and it's warm,
Our old friend the west wind
Will guard us from harm."

The jingle had no more sense in it than any other folklore. Absurd!

A mile to the north his transmitter was hidden. He'd pick that up, make a quick report, and then go on to the town two miles farther still. There'd be material for a magnificent broadcast there. He'd sacrificed Elsa and his hopes of advancement in his profession for the sake of making these broadcasts as a patriotic sacrifice. But a picture of a town of fifty thousand inhabitants, whose people had walked out of their houses never to return, and carrying only such objects as they could hold in their arms—that should rouse his countrymen! A town of intact, furnished, untouched homes, whose windows were unbroken and whose roof tiles were still sound, lying dead and empty beneath the lowering clouds. His countrymen would be ashamed. He'd make them feel as he did, that it would have been better for the town to be obliterated in an atomic bomb crater than to be tamely yielded like this!

He found the highway and marched toward his transmitter, half his mind busily making phrases and the other half savoring the queer, creeping horror of desertion. He automatically felt for the pistol in his pocket. Any crime could be committed here tonight, and there would be no conceivable punishment.

But there was no one left to commit a crime! The army had been through. Known criminals were rounded up and taken away first. Then the inhabitants of slums, who would be least able to resist the temptation to loot. Then the middle classes, and the well-to-do last of all. The army had been efficient in evacuating the population it would not fight to defend. There had been praiseworthy speed and efficiency in moving the population of a province from its homes, leaving the homes intact and in perfect condition for the conquerors who would take them over without firing a shot.

But Igor, left behind, was lonely! Even his shame at his country's submission; even dramatic pictures forming in his mind of the proud holocaust that should have been—even these did not keep him from feeling a queer, lost-child desolation in the now-empty province. His heels were horribly loud on the metaled road. He heard insects in the fields about him. The mournful cry of a night bird. But he walked quietly—because there was no one else within many, many miles.

He found his transmitter. It had been concealed in a little patch of

woodland, and he breathed quickly as he hunted for and found it. Absurdly, he gripped his revolver as he set up the directional antenna and waited for its tubes to warm. Then he angrily swore at himself for a fool. He threw the microphone switch. He murmured into the mouthpiece:

"Calling my fellow citizens! Calling my fellow citizens! I am speaking from the Province of Shame—"

A voice said hurriedly into his earphones.

"Call later, Igor. We're having trouble with the recorder."

He disgustedly turned off the tubes. He stood up and slung the transmitter over his shoulder. He was abruptly and blessedly furious because he began to feel ridiculous. He had undertaken this task in the fine high frenzy of raging patriotism. He could only find the Conservative Party to back him. It was the only one which, because it was hopelessly in the minority, could afford to oppose the national disgrace of giving in to his country's traditional enemy. Igor had not liked it that in making his broadcasts he was helping a pack of pursy, asthmatic, well-fed politicians to make capital of his action. But they had agreed to record and rebroadcast his reports from the abandoned province as the enemy marched in. It should rouse his fellow countrymen to the bitter resolution he himself felt—that it was better to die than to yield farther. But at least the Conservatives could have had competent technicians on the job to do the recording!

He tramped on toward the town, coddling his anger to keep from the sick uneasiness the emptiness all about him provoked. He was twenty-four, and he'd kept his ideals even in the postwar debacle of all idealism. He'd clung doggedly to his belief that sacrifice for freedom was worth while, and that it was right and just that men should die for their country. And he was ready to die for his.

Not that he was likely to be killed. Unless the first patrols of the enemy shot him down in sheer astonishment at seeing a living man in the abandoned province, he would at worst be taken prisoner. After that, of course, he couldn't know what would happen. He had toyed with the idea of getting himself killed as the enemy troops rolled in. But it wouldn't have been even a good gesture—merely silliness. He was sourly disillusioned about even his errand, now. The Conservatives not even having a recorder ready to pick up his report, after having enthusiastically accepted his offer to witness and report the occupation as a means of rousing his country's sense of shame!

He plodded on. He knew that he was nearing the town by the silence before him. All the fields were filled with insanely cheerful, stridulating insects. Ahead was stillness. Empty cobbled streets. Dark and empty houses. A town which lacked only humans to be alive, and was dead because its hu-

mans had lacked the courage to fight. The familiar sickish rage filled Igor again.

Radio was his profession. With cynical detachment he recalled and admired the artistry with which the President of the Council of Ministers had broadcast the decision of the Council to surrender. He could remember that broadcast word for word:

"*The Council of Ministers,*" the President had intoned wearily over the air, "*has been forced to come to a very grave decision. As the public knows, for years our neighbor to the east has been demanding new rectifications of the frontier at our expense. One of our provinces was taken from us some ten years since after a previous demand. In the present case, depending upon our belief in the justice of our cause, we have refused even to negotiate further cession of our territory. It seemed to us aggression by a greater power against a small one.*"

The first scattered houses at the edge of the deserted town loomed up in the blackness on either hand. Igor tramped on, grinding his teeth as he remembered:

"*Last week,*" the President had said heavily, "*our eastern neighbor presented us with an ultimatum. Our refusal to negotiate made, our neighbor declared, a peaceful settlement of the dispute impossible. We were, therefore, informed that unless we yielded the claimed territory without further delay, that a state of war would exist. We were given twelve hours in which to reply.*"

The President had seemed to swallow a lump in his throat.

"*We are a small nation. Our neighbor is a great one. We have atomic bombs, but so has our neighbor. In a total war, of population against population, we could not hope to survive. So the Council of Ministers has ordered the evacuation of the territory claimed by our neighbor. We will not resist its occupation. But we cannot consent to be absorbed, province by province, until our nation shall cease to exist. We have yielded in this instance, but only to this extent: We will not offer armed resistance to the entry of their troops. We will not expose our cities to bombardment and our population to massacre by a total war. We will not take any action against the cities or the civilian population of our neighbor unless forced to do so in retaliation. We say simply and solely this—that any alien soldier who crosses our borders does so at his peril.*"

The President's address had ended, then, and Igor saw with cynical clarity that the mysterious note on which it closed was masterful. It suggested menace. It suggested a source of confidence which should preclude despair. It gave Igor and his fellow patriots something to talk about, something to guess about, something to hope about—and it held off revolt until revolt was too late. Now Igor knew that the President's threat had been as empty of meaning as the nursery rhyme about the west wind that would save one from harm.

The earth about him was empty.

now, abandoned to an enemy who would march in and find waving grain fields and snug cottages and factories and mines and the entire equipment of civilization ready for his enjoyment. There had not even been a removal of machines from the abandoned industrial plant. Only the population had been taken away with what they could carry in their arms—and their livestock, even to the dogs.

Igor was in the city, now. His footsteps echoed hollowly from the house fronts on either side. And it was heartbreaking. The city had been emptied so recently that it still had even the smells of occupancy. There was the smell of bread about a bakery—left with unlocked doors. There was an earthy odor of vegetables about a greengrocer's shop. Its stock was intact, not yet rotten. There were no street lights, to be sure, nor even the faintest glimmer of a night light burning in some one comfortable dwelling, but the city seemed more ghostly because of the smells of occupancy than if it had been empty for a hundred years.

Igor fumbled his way to the square in the city's very heart. There was a statue there, a monument to Paslic, the greatest of the country's national heroes. It would be a splendidly ironic site from which to broadcast the desolation and the shame of this surrender.

He went to the steps about the statue. He unslung his transmitter from his shoulder. He aligned the unfolded directional antenna with the aid of a tiny, luminous dial compass. He turned on the transmitter tubes once more.

Then he heard a sound. Footsteps, furtive and soft. He reached for his pistol. Then he remembered, and bitterness overcame him. A robber? There could be no robbery where all property was abandoned. There could be no murder where there was no law. This was no man's land. This was the Province of Shame. He said ironically into the darkness:

"Good evening, friend!"

The footsteps stopped. Silence. Ear-cracking stillness.

"Good evening, friend!" repeated Igor sarcastically. "You dodged the soldiers, too? We are the only inhabitants of this city, tonight!" The silence continued. Igor said bitterly: "Oh, no need to hide from me! I'm no soldier or policeman! If you're doing a little looting, more power to you! You might as well steal as the soldiers who'll come from the east tomorrow. They'll steal! It's even patriotic to rob your fellow countrymen rather than let them do it!"

Stillness. Then an irresolute sound as if someone uneasily shifted his position.

"I'm a broadcaster," said Igor, in a fine, angry bitterness. "I slipped past the patrols to watch the occupation and broadcast it for the people who'd rather give in than fight. Hm-m-m—how'd you like to broadcast? Your voice in every home of what's left of our country? If you're a thief, so much the better. You can boast of it, because even

a thief has the right to be scornful of the Council of Ministers! Come and talk into my microphone!"

Shuffling, shambling footsteps approaching cautiously. A hoarse, rumbling voice:

"Broadcast, eh?" The figure coughed, and suddenly a brilliant flashlight beam smote upon Igor. "Eh, yes! Y'are a broadcaster. That's a set a man carries on his back to talk for the broadcasting stations, eh?"

The words were mumbled. The accent was barbarous.

"To be sure," said Igor, blinking in the light. "And that's a very fine flashlight. You've been looting already. Good for you! What you steal, the enemy won't get!"

The flashlight went off. Igor felt rather than saw that the figure in the darkness was clothed in the shapeless, bulky garments of a peasant. It rumbled suspiciously:

"You talk . . . eh . . . maybe y'are a broadcaster, at that! Who else is with you?"

"I'm alone," said Igor. "It's my job to make our fellow citizens ashamed. Want to help? Any more of you? If there's a half dozen or so, the lot of you could make a fine record." Then he said fiercely: "Hah! You're a patriot in your way, aren't you?"

The figure mumbled.

"Got all the loot you can carry?" demanded Igor. "Got more hidden? You've had hours! Look! If you've a few companions, we'll set fire to this town—it'd take a half a dozen of us to set it properly alight in enough places—and we'll broadcast to the Council of Ministers, that we—thieves and peasants—have more courage than our betters and we've burnt at least one town so our enemy can't take it over unharmed and laugh at us for our cowardice! We'll make the broadcast with the roar of the flames behind our voices!"

The figure rumbled again and came closer. It chuckled. Then the flashlight beam came on again. In the beam and bearing on Igor, a hamlike hand held a pistol.

"Stand up!" snapped a voice which was neither hoarse nor illiterate. "Raise your hands or I shoot!"

Igor caught his breath. The hand's grip tightened on the pistol. He stood up. He ground his teeth as he felt himself handled by fingers searching him expertly. His pistol was taken away.

"Ah!" said the voice which had changed so remarkably. It sounded satisfied. "One thing more and we'll talk!"

The flashlight beam shifted to Igor's transmitter. There was a crashing, crackling sound. The figure of the night stamped on the instrument. It was smashed to utter uselessness. And such fury filled Igor as he had never felt before.

"I see!" he said in a thick voice. "You're a last patrol hunting for patriots like me, for fear some of us would burn down our towns before letting the enemy take them!"

The voice was amused.

"No, not that."

More stampings on the already-smashed transmitter. Igor's hands clenched. Then his breath stopped. He said eagerly:

"Listen! Are you . . . did the President have something in reserve? Are you . . . setting an atomic-bomb trap for the enemy? Arranging for the town to blow itself to bits when it's full of enemy troops?"

The voice chuckled a second time.

"Not that either, Mr. Broadcaster. I'm a spy, if you please. I'm a captain of engineers in the army that's to march in here in the morning. Your enemy! I parachuted down three hours ago with a platoon of my men, all equipped with Geiger counters and ionization chambers, to look for just such atomic traps. It's been entertaining to listen to you. As far as I know, you'll be the only prisoner taken in the occupation movement of our army. Now, face about and march!"

The pistol muzzle prodded Igor in the back. It urged him on through the darkness.

The dawn came up with a sound that was greater than thunder. There were still lowering, thick, dark clouds overhead. There was a sullen gray lightening of the darkness which was night. There was a dim and angry red glow low down upon the horizon. Then there was a droning, rumbling, growling sound that seemed to fill all the world. It was plane engines in greater numbers than Igor had ever dreamed could be heard at once.

The planes were close before he could pick them out against the low-hanging sky. First there were small fighter planes, driving on at the lowest, impatient speed at which jet-driven planes could stay aloft. There were scouts and light bombers,—combat craft, capable of infinite destructiveness against personnel. Then came the big bombers. Huge flying wings that looked like bats against the dark-gray clouds, flaring flame and vapor from their after parts. They came in lines, in massed formations, by dozens and hundreds and it seemed by thousands. Had the sky been light, it would have seemed that they darkened it. They roared and bellowed over the empty city, rigidly spaced and monstrous in size and number and velocity. They swept over and beyond, and others followed them.

Waves of sound filled all the universe. Igor felt the air throb to the deep-toned, hollow roaring. Standing on the upper balcony of the city hall of the deserted city, it seemed to him that he was battered, was pounded at by sheer waves of sound. He was deafened. He was in agony. And still the fighters and the bombers roared on and on and on. There were thousands of them. There was a squadron of the hugest craft for every small single seater his own nation could send aloft. The smaller craft were literally innumerable. The sky was speckled with them. The air was burdened with the larger ones. There seemed no end to the stream of air-borne might and destructiveness. A nation with such an air fleet needed no atomic

bombs to overwhelm a smaller neighbor. It could smother by sheer weight of numbers.

The noise diminished. The bigger bombers had passed. Only more fighters darted by, higher than the bombers had been, almost in the clouds.

Igor's captor grinned at him.

"If your army plans any tricks," he shouted above the deafness the roar of jet motors had left with both of them, "if your army has any idea of a surprise attack, our air fleet alone could take care of it!"

Igor swallowed. There were the two of them upon the high balcony of the city hall of the abandoned city. The light grew momently stronger, and down in the central square before them his captor's fellows were comfortably busy. One group had set up a microwave radio, aimed to eastward like a machine gun. Men with headsets sat beside it, some reading into microphones, some typing busily. Other clumsily-clad figures cooked over an open fire made from the smashed furniture of the city council room. There were stoves and there was fuel in any number of deserted dwellings, but soldiers have a tradition of destruction. They cooked over a fire of shattered mahogany, and tossed on gilt-framed portraits to make it burn the brighter.

"Our ground forces aren't far behind," Igor's captor shouted again, bending closer. "You'd better get ready to do some talking! I got the devil for smashing your

transmitter, but you'll tell what you know regardless!"

Igor felt whipped by the tumult which had thrashed at him from aloft. But he said fiercely:

"I've told you! I'm a civilian! I thought we should fight! I came to make broadcasts for recordings that would be played—"

His captor laughed.

"Nonsense! You'd some trick frequency on that transmitter that would set off a bomb or two after we'd occupied this town! But you won't do it now! And you're going to tell all you know! We caught that broadcast by the President of your Council of Ministers! We know of the warning that any soldier who crosses your border does so at his peril! You're going to tell us what that peril is!"

"It was a bluff!" raged Igor. "The President said that to keep us patriots from revolting and

throwing him out of office for surrendering to you!"

The thunder that had come from the east was now a mere faint murmur to westward. The enemy's air armada swept on to the frontier. It might or might not stop there. Igor's flesh crawled at the thought of the devastation that the monstrous fleet could wreak on his country. Without resort to atomic weapons, such a pall of crackling destruction could be laid down in a single raid that his nation would be rendered desolate and helpless. It was helpless now! If that fleet drove insolently on beyond the frontier, there was nothing to stop it. There could be nothing to stop it! If it laid the capital in ruins, if the refugees from this abandoned province had merely left their homes to be massacred in the remnant of their country—

Igor's captor suddenly pointed toward the eastern horizon.

"There we come!" he said zestfully. "You're a prize, my friend! I don't believe a word you've said, of course—your President had some trick in mind—but if you don't know what the trick is you'd better guess it pretty quickly, and you'd better guess right! Our general isn't soft with men who don't tell him what he wants to know!"

The dawn had advanced by a little. Clouds still hung all over the earth, but the reddish coloring at the world's edge had faded, and this was such a gray and dreary morning as was fitting for the shame and perhaps the doom of a small and once-gallant nation.

Far, far in the distance there was movement. It was a swarming of crawling motes. There was first a brisk, whizzing movement of very small shapes indeed. They were motorcyclists, darting here and there and everywhere, not only on the highways but all over the fields, investigating every square yard of the soil and every patch of woodland and underbrush. They slipped inquisitively into every homestead and barnyard with the insatiable curiosity of the forerunners of a marching army of ants.

But this army was not ants, despite its multitude. These were men. The scouts searched hastily with instruments far more sensitive than any human sense organ. They quested for areas in which neutrons or gamma rays or other impalpable particles might be present in even slightly excessive number. The presence of excess subatomic particles anywhere might indicate radioactive material in concealment, which might mean atomic bombs. But they found nothing.

The invading army rolled forward like a swiftly flowing tide. Behind the motorcyclists came armored cars, tracking ruthlessly through the growing grain. More delicate instruments still made more sure that the peaceful countryside was no deathtrap for the legions yet to follow. After the armored cars came tanks. Light tanks by hundreds. Medium tanks by thousands. Heavy, clanking monsters, lurching and rolling in a horrible

panoply across the emptiness which had been abandoned to them to be crushed beneath their treads.

Igor's knuckles turned white as he gripped the balcony rail of the empty city hall. This was no mere inflow of an occupation force. This was the army—the main army—of the eastern nation on the march. It moved in terrible, overwhelming strength. It did not merely take possession. It invaded, though quite unopposed. And invasion in force of a province emptied for its occupation had a flavor of the absurd which was not in the least amusing. The mobilization of such might, in spite of the lack of even a dog to bark defiance at it, was more menacing than anything else in the world could have been. It could not be checked by armed resistance, much less by capitulation to its demands. Seeing the force which entered the empty province, Igor knew more bitterly than ever that the sacrifice of territory had been in vain. His country was doomed in its entirety. These troops could overwhelm it almost without a pause. The army and air force of Igor's country, against such a force, was no more able to resist than the west wind of the nursery rhyme.

Inexorably, the invading army swept across the visible land to the east and reached a point level with the city from which Igor watched. The scouting motorcycles divided before it and went racing and dashing hysterically here and there across the open fields. They closed together again beyond the city and went on to westward. Behind them came the armored cars, almost as many in number. After them came the tanks; light tanks and growling medium tanks and the swaying monsters with turrets from which long and deadly guns lolled out.

The streets of the deserted city filled. An orderly came rushing to the platform from which Igor and his captor watched. Igor's captor ran down the stairs, and the orderly prodded the stricken and raging Igor to follow. He reached the open air of the square about General Paslic's statue just as a cavalcade of sleek staff cars drove briskly into it, dispersed themselves according to patently prearranged plans, and disgorged shoulder-tabbed officers who saluted each other and chatted brightly in the slightly annoyed satisfaction of officers who have conducted a completely uneventful advance.

Igor's captor, his peasant's costume now stripped off to reveal the melodramatic uniform of a paratrooper, stood at attention before an officer with a general's stars. He spoke, plainly preening himself. He beckoned, and one of his men brought Igor's smashed transmitter forward. The general glanced at it indifferently and gestured with his hand. An officer rushed it to a lumbering technical-service truck just entering the square.

Igor was led forward. He was suddenly very calm. It was the numbed composure of despair. His country had surrendered a second province to the threat of force, and

the province had been occupied by an army capable of sweeping away any conceivable resistance in the rest of the nation. And therefore, the surrender of this province had merely saved the invaders a few lives. That was all. The army had not fought with its new weapons. It craved to be tested against a suitably inferior antagonist, so that it could taste the pride of victory. So—Igor knew that his country's yielding had been quite useless. It meant only that fighting would begin nearer the heart of the smaller nation, against an enemy already flushed with triumph, and with the smaller and weaker nation already stunned by disaster, crowded with refugees, and convinced of its coming doom.

The general regarded Igor with lackluster eyes. He was a high-ranking general, Igor knew. He recognized him from photographs seen long before. But in his strange, despairing calmness Igor saw more than an enemy. He saw that the general was a wholly commonplace man, pompous and strutting because that was the tradition of his army, but without conviction. He was a puppet of his government, without will or conscience of his own, and therefore he would be more merciless, more ruthlessly brutal, more hideously inhuman in his commands than a man who dared to think for himself.

"You were sent," said the general, "to detonate atomic bombs when our troops should have taken their positions. Tell me your orders and the position of the mines."

Igor hated himself that he had to moisten his lips to reply.

"I had no orders," he said stiffly. "I know of no mines. I stayed behind with a radio transmitter to broadcast an account of the entry of your troops, for recording and rebroadcast to make my fellow countrymen ashamed that they had surrendered."

The general waved his hand impatiently.

"You are not in uniform. There is no reason why you should not be shot out of hand. What are your orders and where are the mines?"

"I have no orders!" repeated Igor fiercely. "There are no mines! I am ashamed that there are no mines!"

The general frowned. An officer behind him murmured softly.

"No," said the general without emotion. "He would say anything at all, merely to escape the pain. Drug him and question him under the drugs. Make sure he tells all he knows. Then hang him."

He dismissed Igor from his mind. Igor was dragged away. And he had thought that he hated his country's enemies before, but it was as nothing to the rending passion that filled him now. He said thickly to his guards:

"You'll get nothing out of me! I'm not needed to take care of you! You'll destroy yourselves!"

And then he ragingly filled his mind with pictures of destruction such as he longed to have fall upon the invaders. He imagined death raining from the skies upon them.

Death rising from the bowels of the earth to engulf them. He trembled with his hatred. He had no hope, of course, that he himself would live to see the sunset. But he lashed himself into a veritable frenzy of hate—and he thrust away most fiercely of all the secret thought that gave him sound reason for just this passion.

He blanked his mind to all but hatred as, held fast in the counter-intelligence-service truck that was especially equipped for the questioning of prisoners, he felt the needles inject the drugs which should rob him of all resistance to questioning. He did not expect to wake. He expected to be dangling at the end of a rope before the hypnotic drugs wore off. And therefore he hated the enemy, and envisioned all that could destroy them and every disaster that could befall.

It worked. The adrenalin of fury fought the soporific drugs. The world became a dim land in which he raged futilely but triumphantly against the invaders. Soothing voices asked questions, and he panted joyously of cataclysms which would destroy them all.

He was very, very cold and sick when consciousness came back to him. There had been no compassion whatever in the treatment given him. It did not matter whether he died while being questioned or afterward. He remembered groggily that he'd shouted at them until they drugged him almost to unconsciousness, and then he'd whispered gleeful prophecies of what would happen as they found out the peril which awaited every invading soldier. It seemed to him—but he was sick and dizzy and confused—that he'd told them that their own actions would set off the devices that were to annihilate them. And from a misty memory of questions about radio, he believed that he'd given them the impression that their own intervehicle radios were to be the means by which their destruction would be released.

That, of course, could very well have been arranged, but he was bitterly sure that there was no death trap set to harm the invading soldiers at all.

He realized that the surface on which he lay was moving. It bumped and lurched and swayed. He was in a vehicle of some sort, a truck perhaps, moving down a metaled road. Then he heard voices. Guards, no doubt.

". . . Lucky . . . own radio sets working some kind of timers . . . not too much detail . . . plays the devil, though . . . general ordered all short-wave communication stopped . . ."

Nausea overwhelmed Igor, lying on the floor of a bumping truck. But he felt a silly sick triumph nevertheless. They thought their own short-wave radios would ultimately set off atomic bombs hidden somewhere. So they'd stopped using short waves. He'd accomplished that much. He'd made that much confusion among the invaders. Of course, it would make no difference in the end. His country would be overwhelmed and extinguished. It

would have been better to have fought from the beginning; to go down in a welter of atomic flame. But, puny as was his revenge, at least he'd done that much! He'd made the conquerors a little bit ridiculous.

Then weakness swept over him like a flood. He blanked out, as the enemy vehicle carried him somewhere unguessable. Undoubtedly, though, he thought in a last flicker of indifferent consciousness, undoubtedly he was on the way to wherever it might be that they would hang him.

"Look here," said Igor carefully, to the white-coated, blank-eyed psychologists who regarded him in completely inhuman meditativeness. "After what I've been through, you can't expect me to be afraid of being shot! And you know that you've got just about everything that my conscious or subconscious mind can give you. There simply isn't anything more to be had from me. I don't know any more! So there's no use!"

There was silence. A figure said detachedly:

"We merely debate what to do next. Under the first hypnotics, you spoke of destruction awaiting our army. Now you deny all knowledge of anything of the sort."

"Naturally," said Igor, "at the time I was ashamed and raging. I was to be hung. Anybody would say anything to do all the damage he could under such circumstances! I worked on your counterintelligence men to make them believe there was something drastic in store for them and all your army. Who wouldn't have tried to do that? And"—he added in grim triumph— "I managed it! I'd had a short-wave radio transmitter and you people thought I'd have touched off something with it, somehow, so I've got your army afraid to use its field-sets for fear they'll set off atomic booby-traps! You marched thirty divisions into my country, when one would have been enough to take over the province you demanded. I think they were going to go right on and annex the rest of the nation, too. But they're stopped, now. They're sitting tight right where they are. They're even using wire-telegraph and couriers and ground-to-plane signaling for communications. Quite a bit of accomplishment for one man, don't you think?"

One of the white-coated figures said reflectively:

"If you lie, now, it is to get your traps exploded by our actions in the field. If you tell the truth, it is because you know we will not believe you. We must plan something quite decisive, to make quite sure just what you have managed to hide from us."

Igor licked his lips. He had been in the enemy capital for thirty-six hours. He had been examined in every fashion that science could devise. Physical torture had been limited only by the fear that—after the course of hypnotic drugs designed to shatter all normal controls—too much agony might make him simply go mad and be useless for further questioning. He was a

jangling mass of quivering nerves. He was weak. He was exhausted. He had suffered all that they dared do to him: And if he had courage now, it was because he had no hope whatever. He was possessed by the terrible exhausted composure of a man who has already experienced the worst that anyone would dare to do to him.

"The President of our Council of Ministers," he said as carefully as before, "said that our nation would not consent to be gobbled up province by province. He said that we would not attempt to fight a total war, with the certain death of many or most of our citizens an inevitable consequence, but that any alien soldier who entered our territory did so at his peril." Igor paused. "I can't add anything to that. I hope that it was not only a bluff. I think that your army had orders to go on and occupy our entire country, if it looked practical. I hope that if they had such orders, or if they carry them out, that they will be killed to the last man, and that you and all your fellow countrymen die as horribly as it is possible for human beings to die."

He said it without anger. There was no longer any strength in him for fury, and these enemies would kill him presently in any case. If it suited their purpose to kill him by slow torture, they would do so, and, if it did not suit their purpose, they would not do so. Nothing that he could say or do would make his death easier or harder. Certainly he could do nothing to avoid it.

They waited, looking at him with the same abstracted, unhuman speculation. They were the leading psychologists of the enemy nation, but they were frightened men. They were required to find out, from Igor, the nature of the threat the invading army faced. And so far they had not found out. They couldn't. He didn't know. But they did not dare kill him without finding out. Now he saw a faint, hidden hope beginning to appear among them. He had begun to talk of his own volition. They listened, in the hope that something would slip that violence and science had previously failed to extract.

"I have guessed," said Igor, wearily, but only because they would do no more to him while they had hope of a slip on his part, "that our President made his speech only to keep his hand from being forced by those, like myself, who wanted to fight to the death. He made the speech in order to accomplish the surrender to you. He hoped despairingly that you might be content. When I felt sure of that, I rebelled even though it was too late. I tried to do my small bit to make sure that not he nor anyone else would ever surrender to you again!"

They watched him. It was intended to be unsettling—to make him nervous. He understood and was drearily amused.

"It still seems most likely, to me, that our President merely bluffed. But I hope that I am wrong. We have atomic energy, as you have. We have only large power-installations, that I know of, but we may

have atomic bombs and other forms of atomic-energy missiles. Or it is possible that our scientists have found a deadly form of radiation that you do not know how to detect. Perhaps your army is actually already dead, in that every man may have been exposed to deadly radiation as he crossed the border, and his death is already certain."

One of the white-coated figures said flatly:

"The most careful check of a large number of our soldiers has shown no sign of injury from any sort of radiation."

"Perhaps," said Igor, "there are monstrous atomic bombs placed so deeply underground that no detector can discover them."

"We have used detectors," said another man shortly, "which would detect a critical mass at more than a mile, behind the most effective shielding yet devised."

"Then possibly," said Igor, "our President spoke out of his knowledge that your seizure of our provinces is unjust. Perhaps he knows that the unjust do not prosper. Perhaps the peril to your soldiers is not contrived, but is a simple natural law, such as that they who live by the sword will die by it, and they who rule by terror—"

"Military policies," said one of the white-coated men harshly, "are not determined by superstition! And there is a specific danger! Your President's threat would not prevent the occupation of territory, and he knew it. Today we sent him a second ultimatum. We had evidence, we told him, that secret devices designed to murder members of our forces had been left behind in the province we occupied. We cited your capture and his speech as evidence that the government of your country was responsible. We demanded immediate information permitting the neutralization and removal of those devices."

"Well?" said Igor tiredly. Nerve-racked as he was, and playing for time, he was not capable of emotion. But he felt, suddenly, that he would give almost anything for a cup of coffee. It would hearten him and strengthen him. It was not a normal reaction. It had all the irrelevance of hysteria. He recognized is as a symptom of his own weakness and was stern with it.

"Your government replied," said the psychologist angrily, "that there were no devices or explosives left behind to its knowledge. But it repeated that every man of our army remained on its soil at his peril!"

Igor shrugged. He had reached a stage of mental and emotional exhaustion where it hardly seemed worth-while even to continue to play for time. But he thought wistfully that a cup of coffee would be very, very good.

"I don't know anything about it," he repeated indifferently. "I did try to raise hell with your cocksureness. Apparently I did. Now I can say that I was bluffing because you won't believe it, or that our President was bluffing either. Maybe you're right. Maybe he isn't bluffing. But I don't know."

"You lie!" raged the psycholo-

gist, suddenly. "No man would surrender and threaten at the same time! Not unless he could make good his threat! It would be insane! It would be suicide!" He snatched out a revolver. "Now! What is the trick your government holds in reserve? Quick, or I fire!"

Igor looked at him drearily. He didn't feel anything. Certainly not fear. But it did occur to him that the enemy was in a deplorable state of nerves because of the President's cryptic warning. Evidently the pressure upon these psychologists to wrest his nonexistent secret from him was extreme.

The white-coated man did not shoot. He subsided, biting his lips nervously. They ordered Igor taken out, so they could consult upon further measures to extract his secret. He submitted lethargically when he was led away to a cell. He might be waked to further torture, to offers of bribes, or to face a firing squad. But since for the moment he was left alone, he practically staggered to the cot the cell contained and fell upon it. He was too shaken and tormented to be able to sleep, and too exhausted even to twitch. He lay still and concentrated all his thoughts upon the idea of how good a cup of coffee would taste. It was soothing to think of a cup of good strong coffee, turned brown with cream— He needed soothing.

Time passed, and he lay in something like semiconsciousness. In the enemy capital outside, flags flew bravely in the sunshine and martial music blared from loud-speakers set up everywhere in the streets. From time to time the brassy music stopped so that magnificently resounding proclamations could be read. No citizen could avoid hearing them.

But just the same, there was tension in the air. The invading army had not been resisted, but it had been warned. If the warning was a bluff, national vanity demanded that it be called—that the army already outnumbering the former population of the invaded province, move on. That it should overrun the rest of the tiny nation which had dared to defy, if only verbally, the dauntless, unresisted troops of holy something-or-other. Some of the enemy population demanded this drastic action furiously. But on the other hand—

After all, there was that warning. Any invading soldier in the occupied territory remained at his own peril? A small nation should not dare to make a threat it could not make good. But what menace could there be? The threat was not to the larger nation as a whole—in fact, it specifically did not threaten the cities or civilian population of the greater country—but only the invading troops.

So the warning could only be a bluff. But it could not be a bluff, because by it Igor's country practically defied the country to which it had just yielded. Yet there could be no explosives or other deadly material in the province! Every square yard of its surface had been checked and checked again! So it

must be a bluff! But the time when a monstrous army was on the march against one was no time to bluff! It was inconceivable that a government could risk a bluff at such a moment

Flags flew in the sunshine, and loud-speakers blared military music, and there were boastful proclamations at frequent intervals. But there was tension. If Igor's nation really possessed some monstrous new device in the art of destruction, it should not have yielded without using it. But if it did not have something new and unprecedentedly deadly, it would not have dared threaten the invading troops.

The Cabinet of the eastern nation bit its collective fingernails, not knowing what to do. The Premier-President would decide, of course, but the Cabinet worried. The

warning, as an insult, justified a declaration of war. Repeated, it was a threat which simply had to be regarded with a certain respect because of its very daring. If the smaller nation could achieve slaughter on a gigantic scale, the invaders should withdraw their army and make peace at any price. But to back down would be to admit a blunder, and the Premier-President could not afford that. So the ruling clique of the eastern nation felt it safer to risk the lives of half a million men than certainly to sacrifice their own prestige. And if risk was taken, they might as well make a glorious campaign and annex the whole of the little western nation. Halfway measures had nothing to recommend them.

But the Premier-President took all necessary precautions. He summoned the commanding general in the field to give a final intelligence report. The general flew back the four-hundred-odd miles from his field headquarters to the capital in a jet bomber that made it in something under an hour. He was ushered into the Cabinet meeting room. He was greeted sardonically.

"It seems," said the Premier-President tartly, "that our neighbor dares us to move again. What are we to do, general? Shall we tremble at the threat? What is your opinion?"

The general sweated and cleared his throat.

"Ha-hm-m-m," he said profoundly. "Excellency, we have found no evidence that the enemy has any military device we do not have. We have found no planted explosives, atomic or other. We are sure that the enemy cannot send them in quantity upon us. We have an air patrol along the tentative border from ground-level to sixty thousand feet, and, of course, our radars watch even beyond the stratosphere. We have issued an unofficial warning to the enemy air force that any plane operating within twenty-five miles of our lines will be considered as intending attack, and that we will take retaliatory measures. So far, his aircraft have not even approached that limit."

"And your troops are dispersed," said the Premier-President. "No air attack could do more than local damage against your army. On the ground, of course—"

"Excellency," said the general, "an attack by ground forces would be simply ridiculous. As for the smuggling of dangerous devices—atomic bombs or other—our technical forces are superb. They assure me that, as far as science can know, we are prepared in every possible level from underground to as high as a rocket can be driven! We are able to smash any attack the enemy could possibly mount! They assure me that the enemy President's threat is only rhetoric which can have no meaning."

The Premier-President glanced around the cabinet table.

"That was my opinion," he said shortly, "only there were some who seemed timorous. If the threat against us is only rhetoric, it is insolent rhetoric, and we will make

use of it. We will proceed as planned. I assume that you have everything in readiness. An hour before dawn tomorrow, we will report the discovery of attempts to destroy our army by a synthetically-created disease of unparalleled virulence and horror. Our propaganda department has designed a quite imaginary disease whose symptoms will take all sympathy away from the enemy who will be accused of infecting our troops with it. On the instant the first broadcasts are made, you will send our air force forward. How long will the complete subjugation of our enemy require?"

The general expanded his chest.

"Two days! Two days, no more! We have devised some improvements on the original tactical movements—"

The Premier-President raised his eyebrows.

"Nonsense! It must not be too easy! So quick a conquest would look as if we were aggressors! You will seize all important objectives within those two days, of course. I shall count on you, general, to run no risks! But . . . ah . . . it would be well if fanatical army groups of the enemy were able to hold out for at least a week, making constant efforts to use ever more horrible and inhuman weapons—which we can count upon our propaganda department to invent. And . . . ah . . . it is necessary that we have a casualty list, general!"

The general said proudly:

"Excellency, the new tactical improvements, cut our probable losses to an almost unbelievable minimum!"

"Are you a fool?" asked the Premier-President coldly. "We must have heroes to decorate! We must have tragic tales to prove that only by superhuman efforts did our gallant soldiers overcome the long-prepared and ruthless machinations of our enemies! We must have victory, of course, and quick victory. We do not want other Powers intruding in this affair. But our people must realize that every sacrifice they have made in the past was justified and necessary. Even you, my dear general,"—here the Premier-President smiled—"will gain far greater credit from a hard-fought campaign than a smashing, overwhelming single victory! Our people must realize that defeat was possible and that only you—and I, of course—have saved our country from disaster."

The Premier-President's expression was quite indescribable. The general swallowed. There was silence. He sensed that he was dismissed. He rose heavily to his feet. The Premier-President nodded affably.

"An hour before dawn as planned. But no superefficient tactics to make things too easy and cut our casualty list too low! We must have our casualty list!"

The general said, unsteadily:

"Yes. How . . . how great should it be?"

The Premier-President glanced about the cabinet table.

"Ten thousand casualties?" he asked amiably. "Normally, that

would be about a thousand killed. Our men, of course, not the enemy."

The Minister of Propaganda frowned:

"Excellency! We should have at least five thousand killed. This is a struggle for the survival of our country, and we win it only by the superlative courage of our soldiers and, of course, the ceaseless planning of our leaders. At least five thousand killed, or it is not plausible!"

"Make it ten thousand if you can, general," said the Premier-President pleasantly. "If you cannot run the list quite so high without seeming to be careless of your men, I will consent to a reduction. But we should have as near ten thousand dead as you can make plausible. That will give us a splendid war, and will justify anything we do afterward with the enemy population."

The general saluted. He made a smart exit. But on his way to the jet bomber that would take him back to his command, his face was gray. He looked like a man who knows despairingly that he is afraid not to do as he is told, and is, therefore, terribly and desperately ashamed.

Igor was not quite awake, and not quite asleep, but in a horrible, nightmarish in-between state in which white-coated men told him brightly that they had a new technique of questioning. They would crack his skull and run its contents through a new examining mechanism, with recording instruments noting down its findings. In that way they would end up by knowing every secret thought and word and action of his whole life. And they had strapped him into a frame which would crack his skull very carefully without injuring its contents—like cracking a nut without breaking the meat—and were having a refreshing cup of coffee before beginning. And Igor envied them that cup of coffee. It was becoming an obsession.

Then a tumult began which drove the dream or delirium away. He opened his eyes vaguely and heard a resonant uproar in the streets outside the place in which he was confined. Hundreds of loud-speakers were bellowing at once, all of them the same words and same voice in unison, but some were farther away then others, so that the fainter outcries of the distant speakers blurred the nearer words. It was very cold in Igor's cell and he shivered and heard the monotonous uproar for a time before he could quite realize what he heard.

The loud-speakers bellowed: *"Citizens! Citizens! Citizens! All-Important Bulletin! Citizens! Citizens! Citizens! Citizens! All Important Bulletin!"* Over the whole capital city the speakers barked, with a resonant and ghostly effect. Presently Igor got groggily to his feet and went weakly to the barred window of his cell. There were pale, unwinking street lights everywhere, shining upon empty ways. The houses of the enemy's city were dark. The citizens had slept. There was a faint, grayish glow upon the rooftops, which was that of dawn-

light yet an hour before the sun's rising. It was somehow shocking to see that colorless luminosity, like fox fire, on the peaked roofs and empty paved streets where the street lamps shone in emptiness and the loud-speakers barked monotonously: *"Citizens! Citizens! Citizens!"*

As Igor looked, though, lights winked on here and there. Such tumult would waken anybody. Sleepy householders stirred, and heard the rhythmic bellowings, and knew unease. A chilly hand of fear clutched at recently-snoring throats. Windows went up.

There was no other stirring, but in a little while the whole city was wide-awake, shivering by open windows and waiting for what might come.

The voice stopped abruptly, and all over square miles of still-dark houses people in their night clothes strained apprehensively to hear.

Then a new voice spoke sharply. Even the hollow, resonant timbre imparted by the distant repetitions did not hide an undertone of fury.

"Citizens! Within the past hour the meaning of the enemy's threat against our soldiers has become clear! In twenty-eight separate places in the occupied territory, a new and deadly plague has broken out! Our soldiers, alone, are the victims! It is no disease ever before known to man! It is a disease created by the enemy in his laboratories to destroy our sons! It is sudden in its onset and terrible in its effect! It is the belief of the enemy that this unspeakably horrible plague will terrify our soldiers from the performance of their duty, and will make them flee from their posts, bringing the foul and filthy disease back to their homeland, where our cities will become charnel houses and the children who stand beside you as you listen will rot loathsomely before your eyes to putrescent corpses!"

Igor ceased to shiver. The professional radio announcer in him recognized that this was his specialty in action. He had planned broadcasts from the invaded province to rouse his countrymen to fury against the fact of surrender. This was a broadcast over a city-wide—perhaps nation-wide—loud-speaker system, for a purpose somewhat akin. It was not a news-bulletin but a propaganda speech. It posed as a newscast, but it was carefully written, with every word weighed for effect. The voice that snapped it out was filled with dramatic fury, not the thick rage of a man roused past reason by a crime. In short, it was a political trick. And Igor ground his teeth for what would follow—but already he knew that it was lies.

"It is the most cowardly device that men have ever used in war!" raged the speakers to the empty streets. *"Those who used it have forfeited the right to call themselves men! It is assassination! It is murder more loathesome and degraded than even our enemy has ever practiced before!"*

Igor clenched his fists in hatred of the enemy which lied.

"But it has failed!" roared the

announcer triumphantly. *"In twenty-eight places the plague appeared simultaneously. Our soldiers were struck down by hundreds! All who were stricken died! But our medical corps rushed into action. Cordons about the centers of infection were instantly formed. Even the doomed soldiers aided in establishing barriers to prevent their contagion from reaching the well. And then, by one of those miracles of destiny which show that our nation is chosen by fate to greatness even beyond the past—by a miracle a medical officer suspected the bacterial type of the artificial plague, desperately tried an antibiotic discovered in our laboratories only two weeks ago—and the plague yielded! That medical officer is the nephew of our Premier-President! His genius enabled him to isolate the plague and stamp it out in the area under his supervision! Word was flashed instantly to the other points where the plague had been sown by our enemies! Already, within the hour, the crime which might have annihilated our nation has been foiled!"*

There was silence. Igor found himself thinking cynically of the obvious lies in this broadcast. That an antibiotic only discovered two weeks before could have been tested, its properties discovered, adopted, a technique for mass production devised and put into operation, its product purified, standardized and issued to an army preparing for invasion. That a new disease could have developed, been diagnosed, treated, and recovery known to be a fact. And—of course—that it was the nephew of the Premier-President who had displayed such medical genius. Igor wanted to laugh, but he choked instead because of what he knew would come next. It came.

"This crime," snapped the loud-speakers in a chorus which went to the horizon, *"this crime shall not go unpunished! As I speak, our troops move forward! Our tanks, our ground forces and our unsurpassable flying engines of destruction, now move upon the enemy to take vengeance for this murder of our stalwart sons! We shall destroy the hellish laboratories where this foul disease was spawned! We shall hang the criminals who ordered it used! And we shall wipe forever from the list of nations the name of that country which was so base as to commit this loathsome deed! But our country, our fatherland, shall lie green and fair beneath the sun, safe in the valor of its sons against all the designs of all its enemies!"*

Igor gulped, leaning on the windowsill behind the thick iron bars, while loud-speakers all over the dark city burst into a blaring of triumphant martial brass. He found himself sobbing, dry-throated, as a chorus of male voices burst into an exultant battle song.

Igor wept for his country. It was a little nation, of barely five million souls. But he had loved it. Its small and ancient towns, its green fields, the great calm quietness of its sunny days, the smell of

grass and the lowing of cattle and all the inconsequential little sounds that could not possibly be the same anywhere else, and now would be stilled forever.

Because, of course, the enemy army was on the march, now. This broadcast had been written and rehearsed and perhaps recorded days since. It was not new, not spontaneous, but deliberate. Undoubtedly it followed after the forward movement of the army, which meant that now the monstrous squadrons of flying things would be aloft in the still-gray dawn. They would be moving swiftly to drop destruction on the little towns that Igor remembered. The air fleet would arrive with a roaring greater than any thunder. The jet fighters would come first over Igor's home city, and they would roar above it in the semidarkness, and the searchlights and the few guns on the ground would strive valorously but vainly to shatter them. And when the batlike bombers came, in numbers great enough to deepen the darkness overhead, there would be thousands of pitiless white flares to float down beneath little parachutes so that the bombers could drop their ghastly cargoes with a perfect precision.

There would be gigantic detonations on the ground, then, and houses would heave upward and settle back in smoking wreckage, with flames licking up and a cloud of thick dust over all. And the futile guns would fire on, desperately, and there would be voices screaming in the wreckage, and constantly more bombs and more bombs dropping to churn up chaos afresh.

And out in the open country, gray dawnlight would show the ground army advancing as Igor had seen it advance over an undefended plain. When the invaders came to little homesteads their guns would spout fire. When they came to villages the monster tanks would crush horribly through them, and sometimes there would be a struggling human figure to be crushed horribly beneath their treads. And the troop carriers would come after, with nervously grinning, excited young soldiers to seize upon the debris of towns and cities, and their guns would spurt death at slight provocation or none, because they would feel like conquerors, and the young girls surviving in destruction would seem to them quite proper and very amusing prey.

When the door of his cell opened, Igor turned to face those who would come in for him. He was not quite sane, then. His face was a gray mask and his eyes burned such hatred as nobody should ever feel. Not ever.

But the men in the doorway were not triumphant. Their eyes were staring and frightened. There was a white-coated man, and a courier whose face twitched uncontrollably, and two of the orderlies in this place which should have been a hospital and was an inquisition instead. And there were four soldiers in the background.

"You!" panted the courier, his eyes panicky. "What did your people do to our army? What—

Drag him!" he cried hysterically. "The Premier-President sends for him! Don't let him commit suicide! Watch him closely."

The soldiers pinioned Igor's arms quickly. They were scared as they marched him out of his cell. And Igor was in the act of tensing his muscles for a maniacal, sudden outbreak in which no man could hold him—no man or number of men—when an insane cunning came to him. He was to be taken to the Premier-President of the country which had destroyed his own. He would pretend to be calm. To be resigned. And somehow, face to face with the man who dictated the enemy's policy in all matters, somehow he would break free and kill—

He went with such docility that the elaborate precautions against his escape were absurd. It was all absurd, for that matter. He was clad in the shabby prison pajamas they had put on him after taking away his clothes for examination in some faint hope of learning some secret from them. His feet were bare. He was unshaven and uncombed and dishevelled. He followed docilely to the elevator, and he marched unresistingly down the marble-floored hall to the outer door, and the sharp chill of predawn did not even make him flinch as he was hustled out to a waiting car.

That car hurtled into motion. It raced with frenzied speed through the empty, echoing streets. And his guards and the courier who commanded them were very silent. So were the loud-speakers, now. It did not occur to Igor, but that broadcast had been a blunder.

They reached a colossal government building. Again Igor in his shabby gray flannel pajamas and bare feet was bustled out and marched up icy-cold stone steps. Then there were sentries, and officers, and an elaborate ritual—but all the officers were gray with fear—and presently Igor was marched into a gigantic office with his arms still pinioned behind him.

The Premier-President looked at him coldly from behind his desk. The office was severe but magnificent. The Premier-President had an air of calm assurance that gave Igor no clue to the reason for his summoning. But Igor was obsessed, now. He maintained the composure of a madman awaiting his opportunity. Only, he felt the muscles of his arms and legs trembling ever so slightly—not with fear, but in an enormous readiness. But he kept his hands lax, lest their clenching give some sign of his resolve.

"Ah! So you are the prisoner!" said the Premier-President acidly. "The only man my troops found in all the province which was surrendered to us! You were to set off the murder devices, eh?"

Controlling his voice to keep the hate out of it, Igor said:

"There were no murder devices. to my knowledge."

The Premier-President sneered at him.

"Come! Come! You had a short-wave radio! There was some frequency which would set them off! You were to wait a chosen

moment and violate all the laws of war by murdering troops which had accepted the surrender of your government!"

Igor was silent. He was still held fast. But a little longer, and a lightning-swift movement would free him for leaps toward that coldly mocking figure behind the desk.

"You have been treated leniently," said the Premier-President in a suddenly soft voice. "You have merely been questioned. Do you know that if I order it you will be staked out here—yes, here in this room—and a tiny pencil flame played over your body, inch by inch, while my doctors inject remedies to keep you alive so that you will live in screaming torment for days on end?"

Igor remembered to lick his lips, as if he were terrified. But he thought that his guards did not hold him quite as tightly as at the beginning.

"What is your government's secret weapon?" asked the Premier-President softly. "I am in haste. For every minute you keep me waiting, you will spend what will seem a century begging for death."

The man meant it. But Igor was suddenly exultant, because he was sure that one of his guards was about to loosen his grip to take a fresh one.

"I do not know." he said. He forced his voice to tremble. "Truly I do not know!"

The Premier-President put the tips of his fingers together.

"I understand," he said—and his voice was deadly for an instant—"that some fool broadcast the announcement that had been prepared, saying that our army had marched on into your nation. That fool will regret it. But the army had orders to make that advance. To this moment, it has not done so. It did not fail to march through indolence! An hour before the marching-time, voices in communication with my staff here grew thick and sluggish. Words grew vague. Men babbled. The stream of reports dwindled, and those that came were unintelligible. I had a rocket plane go to my general's headquarters to demand an explanation. He reported, while in flight, that all was apparently normal, save that there was no forward movement. The air fleet had not taken off. No vehicles stirred. No tanks moved."

Igor's heart gave a bound.

"The rocket plane landed," said the Premier-President evenly. "Its pilot was inclosed in a flight suit which was air-tight and with its own oxygen supply. He reported that men moved about dazedly, and spoke as if in delirium. They were unable to answer his questions except in babblings like those of dreams or fever. Many lay on the earth, breathing heavily. My pilot thought it a plague, but it was not. He was in an air-tight flying suit. He should have been immune. Presently he spoke thickly of a burning thirst and of weakness. He went back to his plane and took off. He crashed."

Then he said matter-of-factly:

"Of course he would have been shot and he and his plane burned when he landed, for fear of plague. Yet I do not think it is plague. What is it?"

"I . . . do not know," said Igor. He was unspeakably exultant, but he was dazed.

"Bind him," said the Premier-President softly. "Bring an acetylene torch. He will speak, or he will suffer as no man ever suffered in all the world before!"

The clutching hands tightened on Igor's limbs. Then an officer raced in.

"Excellency!" he panted. "The President of the Council of Ministers—our enemy!—has asked for a television contact!"

"Arrange it," said the Premier-President coldly. "Here."

He turned his eyes back to Igor. "You have a slight reprieve," he said softly. "I shall show you to your President, as the man who was to set off his devices. I shall tell him that you have revealed everything and that we have already made countermeasures ready." Then he said bleakly, "Perhaps, if all goes well, I will spare your life, but if you give one grimace to tell your President that I lie, the torch will be waiting."

There was a bustling. Igor's brain was sheer confusion, with such honest rejoicing in it that the relief was agony. He saw men roll in a clumsy device with a huge television screen and scanner atop it. A cable trailed behind. A technician worked swiftly at its dials. He sweated visibly. Then he stood up and saluted, his hands visibly clammy with fear.

"Ah," said the Premier-President. He looked at the screen. After a moment he nodded. "You wished to sue for peace, Mr. President of the Council of Ministers? It is a little late! You have struck shrewdly at my army. You will pay for that!"

Igor heard the heavy, weary voice of the head of his own nation. He could not see the screen. That was pointed at the Premier-President. The tones of his own President were as weary and as heartbroken as when he had announced the surrender of the eastern province of Igor's country.

"Excellency," said Igor's president, "I do not sue for peace. I offer it. Mine is a small and peaceful nation. We wish only to till our fields and sit in our own backyards in the twilight. We have no desire for conquest or empire. We wish only to be left alone."

The Premier-President smiled acidly.

"Yet you sowed plague among my soldiers, and—"

The voice of Igor's president interrupted. It was very sad.

"Let us not play. I am heart-sick! We have had to destroy your army! If you will not listen, we may have to destroy your nation! I beg of you to listen to me! We have a means of destruction that nothing can withstand."

The Premier-President smiled widely. It was an excellent smile; a convincing smile. It had even a seemingly authentic overtone of triumph. He beckoned. The soldiers moved Igor, walking stiffly, into the range of the scanner which sent the image of the Premier-President over the television waves. Igor saw the careworn, untriumphant face of his own president on the screen.

"This man," said the leader of all of Igor's enemies, "was one of yours. He has told us all that he knows of your dastardly means of making war, and our technicians have supplied what he did not understand. We prepare not only a complete and unbreakable defense—that is practically arranged now—but a swift and many-times-more-deadly use of your own weapon against yourself!"

He settled back, smiling. He was amazingly convincing. Igor almost admired him. But his own old President regarded Igor kindly from the screen.

"Poor fellow!" he said. "My niece grieves for you, Igor. But, of course, you told nothing. You may tell all now, Igor."

Igor licked his lips.

"Sir," he said, dry-throated, "I . . . can't. They . . . questioned me. I . . . might have told if I knew. But I did not know."

The Premier-President turned and looked at him. It was a sentence of death by torture. He stiffened, because there was nothing that his own President could do for him now, save—

"Tell Elsa, sir—"

"Wait," said the image on the television screen, "I think you can tell our secret, Igor. I know that you once broadcast most interestingly about our atomic-energy plant. And I am sure that you remember the nursery rhyme—the one about the west wind that is cozy and warm and will save us from harm? Ah, yes! I see that you understand. Explain to his Excellency, so that he will know it is very stupid to lie to us and say that he will use our weapon against us! He must make peace, Igor."

Igor had been very pale. Now, suddenly, he was paler. He swallowed.

"Yes, sir," he said steadily. "I will explain his defeat to his Excellency."

"Have him," said his President wearily, "give you facilities for communicating with us. I appoint you our envoy pro tem for concluding an armistice. When you wish assistants, let me know and they will be flown in. We are not vindictive. We shall require the return of our two provinces. I

think we had better keep—and destroy—the equipment of his army. I suspect that they had better hold elections where you are, Igor. And we may ask them to pay for the damage to our crops and homes. But that will be all we will ask. We are a small and peaceful nation, Igor. I shall expect to hear from you very soon."

The television screen went blank. There was silence.

"Well?" said the Premier-President.

Igor swallowed again.

"We have atomic energy, as you do," he said as though his throat hurt him. "Like you, we have found that the greatest difficulty with uranium piles is the enormous amount of radioactive dust they produce. Short-lived radioactive dust, but very deadly. We . . . have found that by utilizing that artificial radioactivity to create more artificial radioactivity, we can . . . preserve most of the usefulness of even short-lived elements, though the element itself dies."

The Premier-President drummed on his desk.

"My patience is growing short," he said, "and there is an acetylene torch waiting to go to work upon you, Mr. Envoy."

"My country's weapon," said Igor quietly, "was radioactive dust. It is the most deadly substance known. We waited for your army to enter, because we hoped they would not. Then we waited in the desperate hope that you would stop there. But your army received orders to advance. So we dared wait no longer. The province you invaded is dead. Radioactive dust fills its every corner. For a time your soldiers walked and lived and breathed in dust which burned out their lives—quite painlessly, but certainly. Your pilot in his air-tight suit was naked before radiations which will penetrate steel. Your soldiers grew fevered. They grew delirious. They . . . some of them may still breathe and move, but they are dead."

The Premier-President said coldly:

"You lie. My troops had air patrols from ground-level to sixty thousand feet. No fleet of planes could have got through them to scatter poisonous dust over all a province! It could not have been done! You lie! What you say is impossible! My scientists—"

"In my country," said Igor quietly, "there is a nursery rhyme about the west wind that will save us from harm. I think it has done so. In this latitude, a few thousand feet up, there is always a wind blowing from the west to the east. The Japanese sent balloons across the Pacific by its means. The early Atlantic fliers flew from west to east with its aid. I think, that my countrymen simply spread their radioactive dust in that west wind. Knowing the size of the particles, they knew the rate of their descent. The wind carried the slowly, slowly falling dust at a known rate in a known direction and let it settle on the earth at a known spot. That spot became empty of all life. Not

only men, but birds and plants and —even bacteria, cannot live where your army lies now. It will not be so for long, of course. The dust will exhaust itself in days or weeks. But your men will have to lie unburied—"

The Premier-President clenched his hands and looked terribly at Igor. But Igor went on evenly.

"Your air fleet could protect your army against another air fleet, but not against small planes spreading dust in the air fifty miles or more within our own borders! No matter how great your fighting ships, they could not defeat a cloud of dust a hundred miles long that ancient cargo planes could make. And"—Igor managed to smile faintly—"you cannot threaten to turn our weapon against us, because the west wind blows from us to you, and not ever the other way about."

There was stillness. A desperate, deadly stillness. Slowly, the face of the Premier-President went gray. Until this instant, obviously, he could not really believe that permanent and irreparable harm had been done to his army. It had seemed preposterous. But—now—it was so perfectly and invincibly simple and inescapable! It was unbeatable. His whole nation now lay at the mercy of the tiny neighbor to the west. Numbers meant nothing. Armies and air fleets and propaganda and chicanery meant less than nothing.

In the province to westward, that had been yielded to threat, his army was very still. The tanks and the planes and the troop-carriers were motionless, with the dead men all around them. As the dawnlight grew stronger, a faint, faint luminosity that lay upon the ground faded and became invisible in the stronger light, but it was there. It would be weeks before any man could enter the abandoned province without walking to his death. But presently—in time—it would be green and smiling again.

Now, though, the men who had expected to overwhelm a little nation and strut as conquerors through its towns lay very still, limply and with glazed eyes in the dawnlight.

The Premier-President was not an imaginative man, but he saw them clearly. He had sent them there. And he heard the terrible cry that would rise from his people when they knew that their sons were dead. The people who had idolized him were little people; common people, but their horror at what he had cost them would turn into anguished fury. He could not face those people. Not possibly.

He stood up from his desk and shrugged his shoulders. He put something in his mouth and chewed swiftly. He grimaced, as if it had a foul taste. He started to walk toward the door. He did not make it. He crashed to the floor and lay still.

Igor's knees felt weak under him. There were white-faced panic-stricken officers suddenly babbling at him.

"What shall we do?" they demanded frantically. "Your govern-

ment may loose another cloud at any instant! You must stop them! Accept our surrender and get in touch—"

Igor walked, wobbling, to the desk of the Premier-President. In his prison pajamas, barefooted and unshaven and disheveled, he sank into the Premier-President's chair because there was no other in the room.

"Take that body out," he ordered wearily, "and get another television contact with my government, and tell the propaganda department to break the news and say that there will be free elections to set up a new and more rational government and—"

He was horribly tired. And there was something that he had been craving for what seemed to him a long, long time. It was almost an obsession, now. He'd had no food in thirty-six hours.

"And somebody," he said heavily, "somebody bring me a cup of coffee."

THE END.

IN TIMES TO COME

Astounding Science Fiction is not and never has attempted to be a news magazine; although our material deals with the future, we can't keep up with today, so far as spot news goes. This, the last editorial material to be written before this issue is started on the press, is written just before Christmas; you will read it shortly after Valentine Day. So it's rather useless to attempt to score any news-beats in our science articles. The news that the XS-1 exceeded the speed of sound—though, paradoxically, planes have flown faster without doing so!—will be stale in February.

But our lead item in the April issue is a science-article, accompanied by a cover by Bonestell. The article is R. S. Richardson's discussion of Men on Mira—rather, it would be a planet of Mira, Mira being interesting in a number of ways. It's a giant, red, variable, and a binary with a blue-white companion. A mixed up system for a living creature to put up with!

Gallegher, the scientist who plays by ear, is with us again, as mentioned last month. And also a novelette by H. Beam Piper, "He Walked Around The Horses," a remarkably well-done item I recommend to your attention. It has to do with the historical fact that a British envoy returning from Vienna during the Napoleonic wars, while stopped at an inn for a change of horses, walked around the horses in full view of several witnesses—and simply, utterly, and forever vanished from the ken of man. Since he was at the time in Prussia, and was an important British Foreign Office official, the investigation was complete and careful—but fruitless. He had simply, seemingly, stepped out of this world—

Or so says Piper!

THE EDITOR.

THE SPACE SUIT

BY L. SPRAGUE de CAMP

***The** idea of the Government's research program was not to build a suit for walking around the Moon, but for riding around in a plane at 50,000 to 500,000 feet altitude. But it comes to about the same problem!*

Richard Farnsworth crept towards the air lock, tugging at his blaster and listening to the sound of drills biting into the tough columbite on the other side. In a minute the lock would fly open, the air in the passage would scream off into outer space, and the Things would pour in. But he, Farnsworth, would be ready for them. As the air pressure dropped, his special duo-servo space suit would be automatically inflated to full air pressure. Inside his helmet he grinned, as, while one half of his keen brain visualized the ganglia of the Things at which he must shoot, the other gloated over the report he would render Professor Glomp, proving the savant's warnings about this suit, which Farnsworth had designed himself, to be entirely mistaken.

With a rending crash the lock flew outward. Farnsworth whipped up the blaster—but then, as the suit inflated, the weapon flew from his grasp as his arms, legs, and fingers were snapped out to full extension by the straightening forces resulting from the excess of pressure inside the suit over that outside. Horrified, Farnsworth found himself standing in the passage in a spread-eagled attitude like that of a gingerbread man, legs spread and arms pointing straight out and up. He strained to flex his joints; but no use—the instant his mighty muscles flagged, his limbs whipped back to their grotesque starfish position. The Things crept nearer . . .

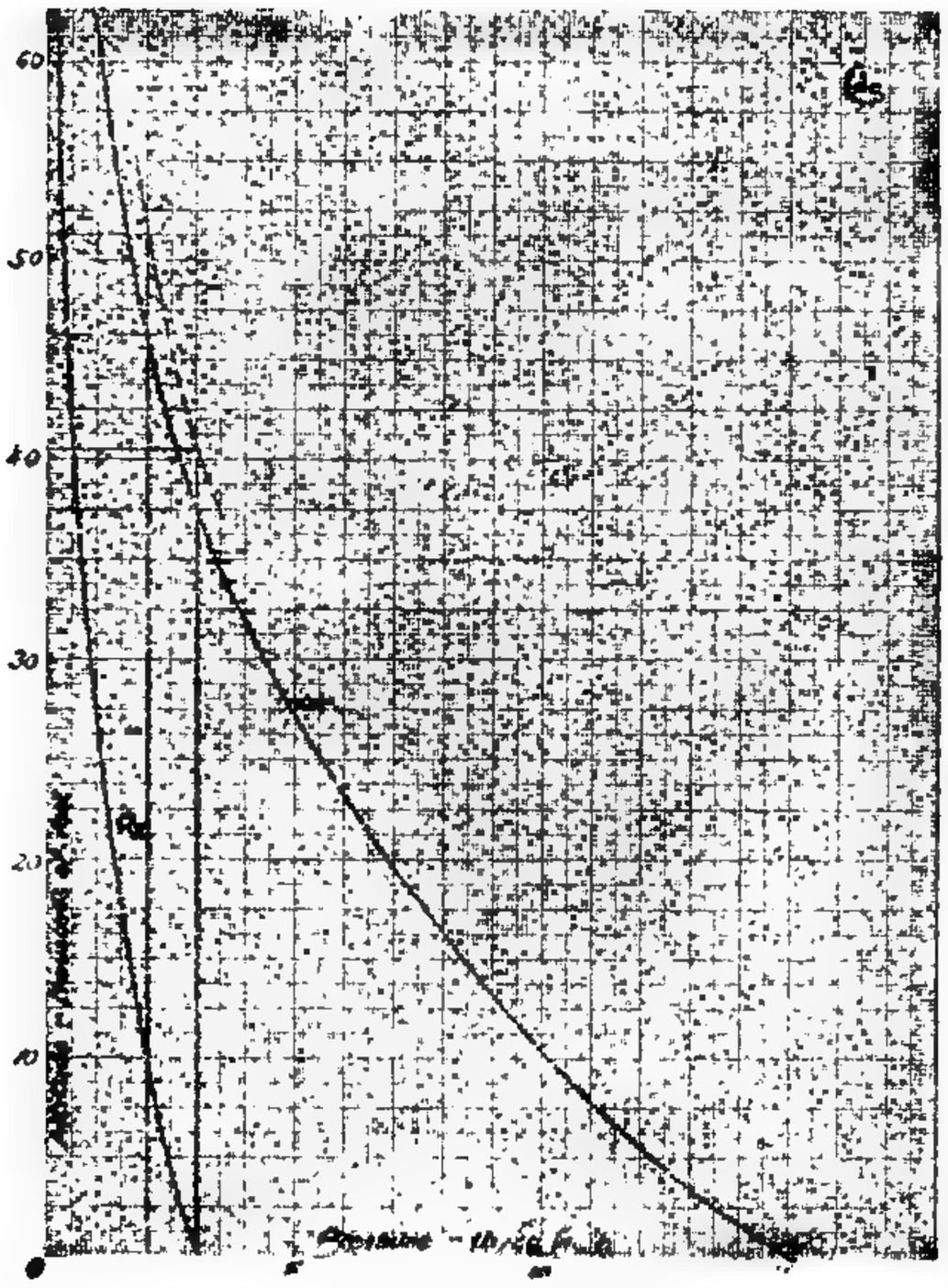
And that, my friends, is what would happen to anyone who tried to wear, in a vacuum, the contraption that most of you have in mind when you think of a space suit. That is not to say that no practical space suit will ever be built. In fact, the formidable problems of space suit design seem fairly close to solution right now.

The earliest fictional use of a space suit that I know of occurred in Arthur Train's "The Moon Maker," which appeared in *Cosmopolitan* during World War I as a sequel to "The Man Who Rocked the Earth." In the course of their

expedition in a spaceship of the flying-ring type to demolish a runaway planetoid threatening the Earth, the characters of Train's story land on the Moon to replace their fuel unit, which they do in space suits. About fifteen years later, when science-fiction magazines became common, the invincible and intrepid Hawk Carse used his suit—a remarkable device with built-in rockets and power-driven roller skates, capable of doubling as a diving suit—to foil some of the vilest villains of space.

Long before Train's story, men realized the need for protection and an oxygen supply in order to explore the upper air. The lethal qualities of this air were demonstrated when in 1862 Glaisher and Coxwell, ballooning to 29,000 feet, almost perished. Glaisher lost consciousness, while Coxwell saved them by opening the relief valve with his teeth. During the following years the great French physiologist Paul Bert built the first altitude chamber and wrote a great pioneer work, "*La Pression Barométrique*," on the physiological effects of changes in the pressures of oxygen and carbon dioxide. His pupil, the meteorologist Tissandier, in 1875 made a balloon flight to 28,820 feet, forehandedly taking along a crude oxygen-breathing apparatus; but despite this precaution Tissandier lost consciousness and his two companions died.

Development of high-altitude breathing apparatus began in earnest between fifteen and twenty years ago, when the perfection of engine superchargers made it possible for military airplanes to operate effectievly far above the altitudes at which unprotected men could survive. Since then oxygen masks, pressure cabins, and even a few embryonic space suits—called pressure suits in official circles—no science-fiction terminology for them!—have been developed. These suits, being designed to operate at finite altitudes, are not true deep-space suits. However, you may reasonably consider them the predecessors of true space suits.



Variations of pressure with altitude. Right-hand solid curve, atmospheric air; left-hand solid curve, partial pressure of oxygen in atmospheric air. Broken curve, pressure in a pressure-breather system.

What are the problems of breathing and living at high altitudes? First, look at Fig. 1. Two solid curves on this graph show the average pressure at various altitudes—the right-hand curve, the total pressure of atmospheric air; the left-hand curve, the partial pressure of oxygen in that air. Air at the Earth's surface exerts a pressure of about fifteen pounds per square inch, of which almost exactly one-fifth is contributed by oxygen, and almost all the rest by nitrogen. (You can ignore carbon dioxide, water vapor, and the rare gases.)

As you rise, the pressure drops until at 18,000 feet it's only half what it was at the surface; at 33,000 feet, one quarter, and so on. The curves would be perfect hyperbolas were it not for variations in temperature, which decreases until it reaches about —65° F at 35,000 feet, and stays almost constant thereafter for many angels—thousands of feet of altitude—more. The level at which temperature becomes constant is called the *tropopause;* the air below it is the troposphere and that above it the stratosphere. Actual air pressures, temperatures, and the height of the tropopause vary with different parts of the Earth, times of year, and kinds of weather.

Now observe that oxygen remains the same one-fifth of the air regardless of height. (We needn't worry just now about the layers of high ozone or O_3 concentration and of high temperatures much farther up.) You can't drastically change people's conditions of air pressure, oxygen pressure, temperature, and humidity without distressing or killing them, and of these the most critical condition is the partial pressure of oxygen. When you rise from sea level to eight angels—where, as you can see, the partial pressure of oxygen is about 2.2 lb./sq. in.—your efficiency is impaired—you're not as strong, as well-co-ordinated, or as intelligent as you were. At fifteen angels—partial pressure of O_2—1.7 lb./sq. in.—your inefficiency becomes dangerous, and you may suffer headache, lassitude, blurring of your senses, chest pains, heart palpitations, and nausea. At twenty angels—1.4 lb./sq. in.—you may lose consciousness if long exposed. At thirty-five angels—0.7 lb./sq. in.—you lose consciousness in thirty-five seconds and die within ten minutes of lack of oxygen—anoxia or anoxemia. The effects of anoxia are somewhat like those of carbon-monoxide poisoning—or to be more exact, carbon-monoxide poisoning is a specific kind of anoxia. Also, long exposure to great cold produces effects somewhat like those of anoxia—drowsiness, et cetera.

If you rise slowly—say over a period of days—you can adapt yourself to altitudes up to 12,000 feet by acquiring the habit of deep breathing. If born at such an altitude, you adapt yourself still further by growing more red blood corpuscles. People who have lived at such altitudes for centuries, like some Peruvian Indians, evolve still further adaptations such as large lungs and an exceptionally large and hemoglobin-rich blood supply, giving

them a purplish complexion. As an aviator or a space man, however, you will have no chance to develop such built-in adaptations.

An aviator can counteract the effect of altitude somewhat by hyperventilation—deep rapid breathing. But hyperventilation is itself dangerous, and may produce symptoms like those of anoxia, up to and including unconsciousness. Hyperventilation works in two ways: First, it flushes all the CO_2 out of the system, making the body abnormally alkaline and upsetting its chemistry; secondly, this lack of CO_2 shuts off the automatic breathing-reflex, which is stimulated, not by lack of oxygen, but by the presence of CO_2. Therefore, unless you consciously force yourself to continue to breathe after hyperventilating, you may lose consciousness from lack of oxygen before your breathing-reflex wakes up and starts your lungs going again.

Particularly, the disorders arising from hyperventilation are *not* due to an excess of oxygen; the idea that you could get drunk on a moderate excess of oxygen arose from statements made during the last century by Poe and Verne in a couple of their science-fiction stories, and has no factual basis. Breathing pure oxygen at a normal sea-level pressure of one atmosphere—fifteen lb./sq. in.—merely stimulates you mildly—like caffein cures hangovers—and can apparently be tolerated indefinitely, although the researches of Haldane show that pure oxygen at two atmospheres or more is injurious.

Aviators, then, have long been counteracting the effects of altitude by breathing pure oxygen. Regulations generally require them to begin breathing it well before they pass the dangerous levels of 8,000 or 10,000 feet, because the most insidious effect of anoxia is *euphoria*—a false sense of happiness and well-being, as in the first stages of drunkenness—as a result of which the aviator, when he needs his mask, cannot realize this need. Or, even if he does realize it, his co-ordination may be too far gone for him to adjust it properly. This may be a very serious matter, because even a slight leak at high altitudes will readily reduce his oxygen consumption below the danger level. Masks have to be made in a number of different sizes and shapes to fit different faces, and woe betide you if your mask doesn't fit just right. The torture of a mask that doesn't fit right around the bridge of the nose can be most excruciating.

A slight degree of anoxia produces dullness of vision and mild hallucinations; for instance, when I went up to 18,000 feet in an altitude chamber without a mask, the white-painted interior wall of the chamber looked yellow, and the hiss of air through the valves sounded like church bells. As soon as I put my mask on the walls snapped back to white. A man of powerful intellect can compensate for the effects of anoxia by being extra careful, to some extent, as he can with alcohol, but it's still extremely dangerous to

expose yourself to anoxia if you don't have to. Some people's nervous systems go haywire so that they collapse in a type of convulsions called "the chokes."

Now, if you breathe pure oxygen instead of air, how much higher can you go? If you draw a line straight up from the base of the oxygen curve on the graph, it intersects the air curve at about thirty-seven angels. Or, if you take ten angels as the maximum safe height to breathe air, and draw a line up from the 10,000-foot point on the oxygen curve, it intersects the air curve at 46,250 feet. On paper, therefore, it looks as though pure oxygen at 37,000 feet, or at 46,250 feet, would furnish you with as good an oxygen supply as air at sea level and 10,000 feet respectively.

In practice the system doesn't work as well as that, however, because there's always a little leakage; your lungs have to pull on the oxygen system to draw the gas through the tubes and valves of the system; and finally the extreme cold of high altitudes reduces the efficiency of your own breathing-mechanism. It has therefore been found that your efficiency decreases notably, even with pure oxygen, at 35,000 feet, and the decrease becomes dangerous at 40,000 feet, although 45,000 feet has been successfully reached in altitude chambers. Different people vary, however, in their ability to tolerate these inhuman conditions.

For some years aviators tried to get their oxygen by sucking it from a tube equipped with a pipe-stem mouthpiece; the balloonist Tissandier used a similar system. Unfortunately, the aviator had to keep his mind on it, and if he accidentally dropped the tube he might easily pass out while groping around the floor for it. So during the 1930s the oxygen mask—a sponge-rubber contraption with wire stiffening and straps around the head—was developed by Boothby, Lovelace, and others. With oxygen masks only the celebrated Soucek brothers flew to 43,166 feet, and the British aviator Reynolds climbed to over 45,000 feet in his Spitfire over North Africa to shoot down a Junkers pressure-cabin photo-reconnaissance plane. Reynolds, chasing the German for an hour between 45,000 and 50,000 feet, suffered extremely from cold, nausea, faintness, and paralysis, but nevertheless returned safely to his field.

However, such feats are possible only to exceptional people. Moreover, at 50,000 feet, even breathing pure oxygen, nobody can long survive because no oxygen will be transmitted through the membranes of his lungs. Therefore, during World War II, pressure-breathing systems were developed to add a few thousand feet more to the aviators' ceiling. A pressure-breathing mask is rigid, made of plastic instead of rubber, and the system is arranged to feed a continuous stream of oxygen to the user, so that it inflates his lungs automatically, as if they were balloons, but he has to exhale against resistance, thus raising the pressure in his lungs and forcing the oxygen through the

membranes. In practice an aviator can tolerate a pressure-increment in his lungs of about 10 inches of water, or .361 lb./sq. in., about the ambient — surrounding — atmosphere. Above that, the pressure causes discomfort and may interfere with circulation.

If you look at the graph again, you will see that the effect of the pressure-breathing system is to move the air curve .361 lb:/sq. in. to the right, so that the vertical lines can be extended up considerably farther before intersecting the new—broken —curve. In practice it is found that a given aviator can fly two or three thousand feet higher than he could without the system.

Another thousand feet or so can be added by a pressure vest—an embryo space suit which applies pressure to the outside of the thorax only, leaving the rest of the body to take care of itself. However, you soon begin to encounter another difficulty as you go higher—lack, not of oxygen in the lungs, but of pressure on the whole body. As you know from physics, the melting-point of a liquid rises, and the boiling-point falls, as you decrease the pressure, until they meet. This applies to human blood, so that at 63,000 feet human blood boils at normal body temperature. Hence an aviator would risk sudden death over 60,000 feet even with a pressure vest. Even if he didn't go that high, too rapid an ascent might bring on the "bends"—aeroembolism, or formation of bubbles in the blood, always painful and sometimes dangerous. During the recent war Lieutenant Commander D. W. Gressley, USN (MC) succeeded in photographing these bubbles by X-rays, and discovered that they were not as some had thought microscopic, but were sometimes almost as big around as a pencil. The effect is exactly the same as that of opening a bottle of beer, when the dissolved CO_2 effervesces out. Large gas bubbles may also form in the gut, with disagreeable results.

A sudden descent, by increasing the pressure, will quickly get rid of the bubbles; but on the other hand it may jam the Eustachian tubes from the middle ear to the throat, so that air cannot flow into the ear as pressure rises. Under these conditions descent from 4,000 feet to sea level may produce enough pressure-differential to rupture the ear-drum—painful and often partly deafening.

You can easily see, therefore, that Stanley Weinbaum's stunt of having his hero dash unprotected across a vacuum space on an airless planet, carrying the heroine in his arms, is quite impossible. The hero would fall unconscious almost instantly, and would be dead in less than a minute.

After men had been talking for some years about pressure suits, the celebrated aviator Wiley Post had one built for himself by the B. F. Goodrich Company in the early 1930s, and wore it on a high-altitude flight. It was equipped with a cylindrical helmet with a flat circular pane of glass in front, rather like a medieval tilting-helm, and was

Experimental pressure suit built by the B. F. Goodrich Co. for the armed services of the United States during World War II. The suit is apparently deflated, and the wearer is wearing a pressure-breather mask inside the bubble-type methyl-methacrylate helmet. Notice the elaborate joint-articulations, the service hose supplying air, oxygen, electricity, et cetera, and the numerous slide fasteners, valves, and other fittings.

supplied with plain air at a pressure of three or 4 lb./sq. in. over ambient. Post flew for several hours in this suit between twenty-five and thirty angels without ill effects. While a good first attempt, the suit would not have been suitable for much higher altitudes.

During World War II, the United States and Great Britain experimented extensively with pressure suits as a method of reaching altitudes above 40,000 feet—the practical limit for masks—alternative to pressure cabins. But although the United States Armed Services procured a number of experimental suits from the leading rubber companies and other firms, at a cost running into seven figures, all these suits showed such marked defects that the end of the war came before any of them had been reduced to practice. Meanwhile the suit's rival, the pressure cabin, had been developed to such a point of usefulness that hundreds of airplanes were built or building incorporating this feature, including the famous P-80 and B-29.

The original idea of pressure cabins goes back at least to Jules Verne, and the French pioneer aeronautical engineer Breguet took out pressure-cabin patents as early as 1908. One of the first to be tried out experimentally was the

elliptical steel tank, 25″ x 40″ x 50″, with small glass ports, which United States Army pilots installed in a De Haviland 4—one of the "flaming coffins"—in 1920. Air was forced into the tank by a windmill-driven blower, and let out by a manually operated valve. On the first flight the supercharging system proved entirely too effective—the pressure leaped to that of 8,000 feet *below* sea level, causing Pilot Harris acute discomfort. Two subsequent flights at McCook Field to 12,000 feet were successful, though the cabin was hardly a practical development because the pilot could barely see what he was doing. The problems of leakage, heating, vibration, fragility of transparent materials, and so forth were all gradually solved during the next twenty years, but that's another story.

Pressure cabins having been perfected, pressure suits are for the time being restricted to the rather narrow field of forced bail-outs from military airplanes at altitudes —above 45,000 or 47,000 feet— where ordinary oxygen equipment won't keep the aviator alive long enough to make a free fall to where it will. Even this use may prove ephemeral, because at much greater altitudes—say 75,000 feet—when they are reached, the airplanes may travel at such high speeds that even in a good practical space suit a flyer who tried to bail out would be killed by the impact of the air stream. For such difficult conditions it will probably be necessary to jettison the whole cabin.

However, the present limited prospective use of pressure suits continues to stimulate their development, and with supra-atmospheric man-carrying rockets but a few years off we may soon see a suit effective enough for strolling the Moon.

Of the many serious difficulties of space suit design, the principal one has been the construction of the joints so they wouldn't become rigid when the suit was inflated. When you apply pressure to the inside of any such body, it takes the form at which it has the maximum volume, and stubbornly resists any effort to bend, crease, or wrinkle it into any other attitude. Therefore if you make your suit with plain straight cylindrical limbs, it will "starfish" —assume a spread-eagle position like that of Richard Farnsworth— and refuse to bend. Some experimenters have tried to get around this obstacle by molding their suits in the position the aviator would assume in his cockpit; but then the poor flyer can't straighten out, and must move about in an embryonic crouch, like that of an aged ape. Others have tried trick articulations —bellowslike joints, or joints like those of a lobster's limbs.

To get around this difficulty, the most effective methods have been to give the wearer a regular oxygen mask—or better yet a pressure-breather mask—feeding him oxygen at the safe minimum pressure of about 2 lb./sq. in., and the rest of the suit air at a slightly lower pressure—say .36 lb./sq. in. less, since not as much pressure is needed on

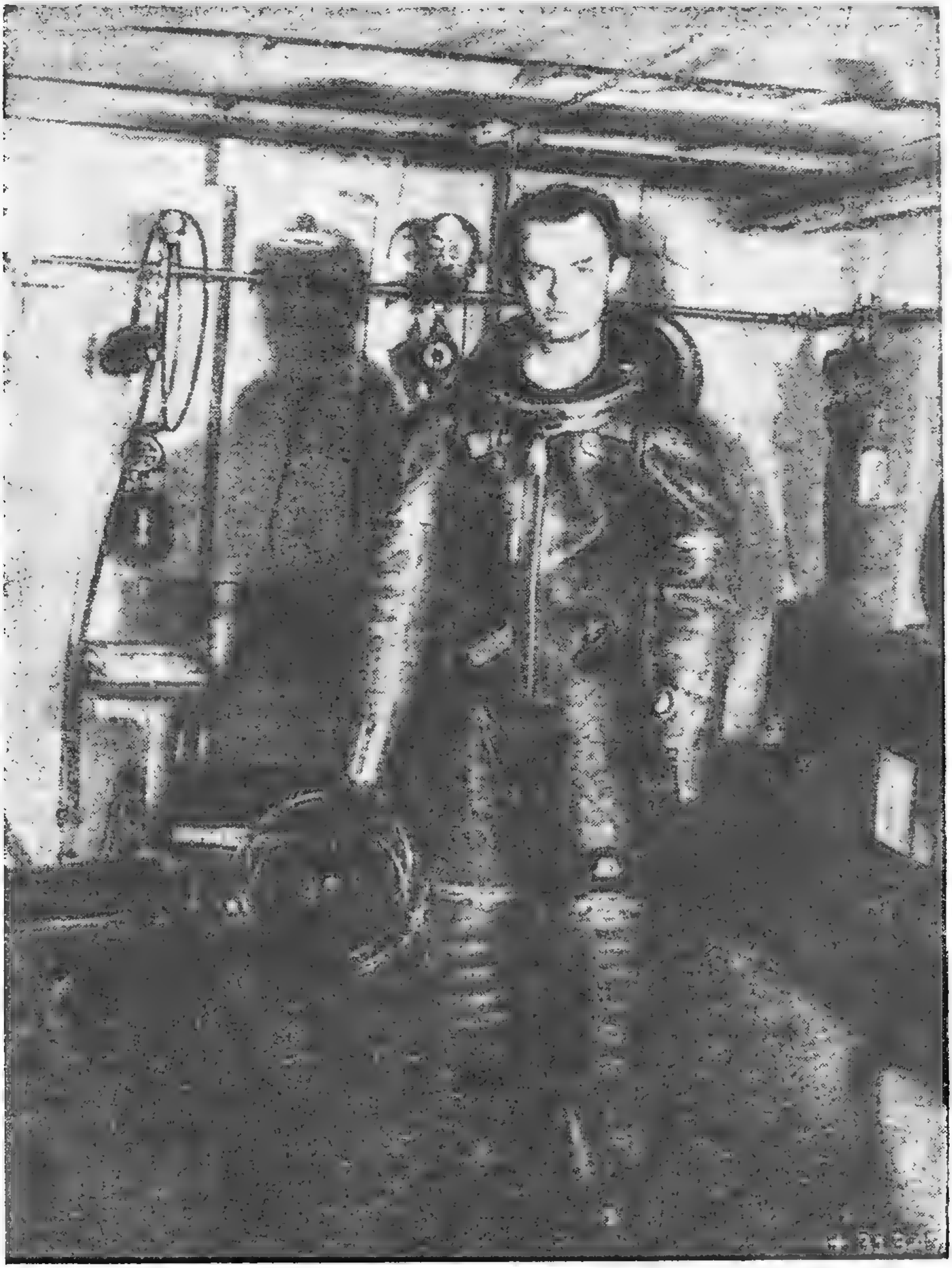
the outside of the body to keep the blood from boiling as is needed inside the lungs to make them work. By reducing the pressure you reduce the torque forces tending to stiffen the joints of the suit.

Another improvement is to make the suit practically skin-tight, thereby reducing the leverage that these forces have to operate with. Perhaps you saw a picture of an aviator getting into a lizard-green suit of this kind in an Army Air Forces advertisement a few months ago. By exquisitely careful tailoring of the joints, it is possible to reduce the stiffening forces still further. It is also proposed to apply the air pressure inside the suit, not to the space between the suit—which will resemble a suit of long underwear rather than an improved deep-sea diver's rig—and the limbs, but to a series of tubes running down the limbs, so that as the tubes are inflated they will draw the fabric tightly around the limbs like a sort of bandage or puttee.

Of course this means that a suit will have to fit very carefully indeed; our Richard Farnsworths won't be able to steal or borrow somebody else's suit to get themselves out of difficulties, unless the somebody else happens to be their twin brother. It will be necessary either to make each suit to fit its wearer, or to supply arms, legs, and others parts in a wide variety of sizes. I remember seeing one suit tested during the recent war on an engineer too small for it; as the suit was inflated, the upper part rose straight up until the engineer could barely see over the lower rim of his helmet.

Another difficulty is that when you reduce leakage, as you naturally try to do, the moisture which normally evaporates from human skin accumulates in the form of water sloshing around the wearer's feet, with all sorts of unpleasant consequences. As a result, you either have to make the suit sufficiently porous to let the air that leaks out carry off the water vapor, or you must supply the suit with some sort of circulatory ventilating system incorporating a dehydrating unit. The leakage system will probably prove too extravagant of air to be practical in a deep-space suit.

Helmet design was greatly advanced by the development before the recent war of methyl methacrylate—sold under such trame names as "lucite" and "plexiglass." I can remember when science-fiction illustrators began substituting bubble-type helmets of transparent plastic for the diving-suit helmets they had been depicting theretofore. Methyl methacrylate, unfortunately, leaves much to be desired from the structural point of view, being temperature-sensitive and notch-sensitive to a high degree; but the plastic chemists will no doubt get around these difficulties in time. It may become necessary to make each helmet of two bubbles or bowls, one inside the other, to prevent fogging, which bids fair to present serious difficulties. It has also been found necessary to provide the helmets with a quick-release mechanism, because, as the Goodrich Company discov-



Another variation of the pressure suit theme. It's noteworthy that all the variations adopted the science-fiction fishbowl-headpiece idea, rather than the diver's-suit type of helmet.

ered, aviators who tried on the suits developed acute claustrophobia until the company made it possible for them to get rid of their helmets in a tenth of a second by yanking a lever.

Oxygen supply and air pressure presents no very serious problems as long as the suit-wearer stays in an airplane—he can get his oxygen from the airplane system and his air from an auxiliary supercharger. For bail-outs at high altitude the armed forces now plan to have the aviator sit in the airplane with his suit deflated until the time comes to jump, when he will inflate his suit, cut off the air supply, switch his oxygen supply from the airplane's regular oxygen to a small bail-out oxygen flask which he will take with him, and jump. They think that the pressure in the suit and the oxygen in the bottle will last long enough for him to make a delayed-opening jump to lower levels.

Such a system wouldn't work for deep space, where there is no air to force into the suit by supercharger, and where the suit-wearer might have to remain in a vacuum for much longer than is expected for the present suits. There are two methods of getting around this problem—to connect the aviator with his space craft by a hose, like that used for divers' suits, which would do for repair work; or to have him carry flasks of compressed air and oxygen with him, which would enable him to explore an airless body like the Moon if he didn't try to go very far and if the value of gravity were low enough there.

For any pressure suit to be used in or on an aircraft or space craft, a knotty little problem in practcial engineering is posed by the design of a connection between the suit and the services—that is, with compressed-air line, oxygen hose, intercommunication system, heating current, and a nonfreezing dependable pressure-relief valve. You practically have to incorporate these services in one single line to prevent the wearer from getting tangled like Laocoon with his serpents. These problems occur in a more acute form when you try to make the suit self-sufficient, and construct oxygen apparatus, a radio, et cetera, small and light enough to enable the suit-wearer to get about.

Suits now under development will combine the skin-tight form mentioned above with a pressure-breathing system, electric heating, and antigravity bladders to protect the wearer against violent accelerations. (You know about the G-suit to prevent blacking out on turns; these new suits will incorporate this feature.) These suits will not be suitable for deep-space work because of their limitations of air pressure and oxygen supply; to make a proper space-suit you need to be able to carry these things about with you for more than the few minutes required to fall through the stratosphere.

It looks as though the final space-suit design would have to incorporate separate air and oxygen systems. The space-explorer may carry these gases either as compressed gases or as liquid. If you want to do some calculating on the problem, I'll give you a set of figures to start with:

the standard 514 cubic-inch oxygen cylinder, designed to hold O_2 at a pressure of 1800 lb./sq. in., weighs about 18 pounds—not too much to handle, even at Earth gravity—and is supposed to last one breather 196 minutes at an altitude of 20,000 feet; longer higher up. The rate of consumption of oxygen depends upon the activity of the person breathing it; it ranges, at sea-level conditions, from 8 liters/min. of air breathed while sitting still in a chair, of which about 250 cubic centimeters of oxygen is actually consumed, to 40 liters of air breathed, of which 2,000 cc. of oxygen is consumed, while walking briskly. Really violent exercise would raise these figures still further.

The problems of air or nitrogen for air pressure on the body are similar, and there is probably no insurmountable obstacle to equipping a suit with a gas supply good for three hours. Incidentally, if you want to see an example of uncontrolled rocket action, just accidentally drop one of these compressed-gas containers so as to break off the valve. The cylinder takes off like an angry hornet and usually batters its way through a few concrete walls before exhausting its charge.

Containers of liquid gases could probably be used to supply the necessary gases for even longer periods, but such a method involves serious problems of manufacture and storage of the gases; you can't cork them up, you know, for if you try they'll blow up on you. Moreover liquid oxygen is a dangerous material to handle; hydrocarbons like lubricating oil explode on contact with it—as for that matter they do on contact with pure oxygen gas. Some of my colleagues at NAES got blown up by a liquid oxygen system they were experimenting with for ordinary airplane use. The big steel tank in which they were keeping the stuff went off with a fine roar, burying one large jagged piece of steel in the ceiling thirty feet overhead, while another grazed the belly of one of the engineers and would have disemboweled him had it been an inch further in. Fortunately the bruise on this lad's tummy was the only casualty.

That, I think, give you a pretty good idea of where we are and whither we're going in the matter of space suits. Whoever tries to develop a real deep-space self-contained suit will run into lots of bugs and little technical problems—for instance, should you put on more slide fasteners to enable the wearer to get into the suit in less than an hour's grunting, or fewer to cut the leakage? But I find consolation in the thought that if there were no such obstacles, nobody would need to hire engineers to solve them.

THE END.

THE ENDOCHRONIC PROPERTIES OF RESUBLIMATED THIOTIMOLINE

BY ISAAC ASIMOV

*An **article** on a remarkable chemical substance. This one seems to have escaped from the J.A.C.S.—probably by request.*

The correlation of the structure of organic molecules with their various properties, physical and chemical, has in recent years afforded much insight into the mechanism of organic reactions, notably in the theories of resonance and mesomerism as developed in the last decade. The solubilities of organic compounds in various solvents has become of particular interest in this connection through the recent discovery of the endochronic nature of thiotimoline.[1]

It has been long known that the solubility of organic compounds in polar solvents such as water is enhanced by the presence upon the hydrocarbon nucleus of hydrophilic —i.e. water-loving—groups, such as the hydroxy (-OH), amino ($-NH_2$), or sulfonic acid (SO_3H) groups. Where the physical characteristics of two given compounds—particularly the degree of subdivision of the material—are equal, then the time of solution—expressed in seconds per gram of material per milliliter of solvent—decreases with the number of hydrophilic groups present. Catechol, for instance, with two hydroxy groups on the benzene nucleus dissolves considerably more quickly than does phenol with only one hydroxy group on the nucleus. Feinschreiber and Hravlek [2] in their

studies on the problem have contended that with increasing hydrophilism, the time of solution approaches zero. That this analysis is not entirely correct was shown when it was discovered that the compound thiotimoline will dissolve in water —in the proportions of 1 gm./ml.— in *mims* 1.12 seconds. That is, it will dissolve *before* the water is added.

Previous communications from these laboratories indicated thiotimoline to contain at least fourteen hydroxy groups, two amino groups and one sulfonic acid group.[3] The presence of a nitro group ($-NO_2$) in addition has not yet been confirmed and no evidence as yet exists as to the nature of the hydrocarbon nucleus, though an at least partly aromatic structure seems certain.

The Endochronometer—First attempts to measure the time of solution of thiotimoline quantitatively met with considerable difficulty because of the very negative nature of the value. The fact that the chemical dissolved prior to the addition of the water made the attempt natural to withdraw the water after solution and before addition. This, fortunately for the law of Conservation of Mass-Energy, never succeeded since solution never took place unless the water was eventually added. The question is, of course, instantly raised as to how the thiotimoline can "know" in advance whether the water will ultimately be added or not. Though this is not properly within our province as physical chemists, much recent material has been published within the last year upon the psychological and philosophical problems thereby posed.[4,5]

Nevertheless, the chemical difficulties involved rest in the fact that the time of solution varies enormously with the exact mental state of the experimenter. A period of even slight hesitation in adding the water reduces the negative time of solution, not infrequently wiping it out below the limits of detection. To avoid this, a mechanical device has been constructed, the essential design of which has already been reported in a previous communication.[6] This device, termed the endochronometer, consists of a cell 2 cubic centimeters in size into which a desired weight of thiotimoline is placed, making certain that a small hollow extension at the bottom of the solution cell—1 millimeter in internal diameter—is filled. To the cell, is attached an automatic pressure micro-pipette containing a specific volume of the solvent concerned. Five seconds after the circuit is closed, this solvent is automatically delivered into the cell containing the thiotimoline. During the time of action, a ray of light is focused upon the small cell-extension described above, and at the instant of solution, the transmission of this light will no longer be impeded by the presence of solid thiotimoline. Both the instant of solution—at which time the transmission of light is recorded by a photoelectric device—and the instant of solvent addition can be determined with an accuracy of better than 0.01%. If the first value is subtracted from

the second, the time of solution (T) can be determined.

The entire process is conducted in a thermostat maintained at 25.00° C.—to an accuracy of 0.01° C.

Thiotimoline Purity—The extreme sensitivity of this method highlights the deviations resulting from trifling impurities present in thiotimoline. (Since no method of laboratory synthesis of the substance has been devised, it may be practically obtained only through tedious isolation from its natural source, the bark of the shrub *Rosacea Karlsbadensis rufo*.[7]) Great efforts were therefore made to purify the material through repeated recrystallizations from conductivity water—twice re-distilled in an all-tin apparatus—and through final sublimations. A comparison of the solution times (T) at various stages of the purification process is shown in Table I.

It is obvious from Table I that for truly quantitative significance, thiotimoline purified as described must be used. After the second resublimation, for instance, the error involved in an even dozen determinations is less than 0.7% with the extreme values being —1.119 seconds and —1.126 seconds.

In all experiments described subsequently in this study, thiotimoline so purified has been used.

Time of Solution and Volume of Solvent—As would seem reasonable, experiments have shown that increasing the volume of solvent enables the thiotimoline to dissolve more quickly—i.e., with an increasingly negative time of solution. From Figure 1, however, we can see that this increase in endochronic properties levels off rapidly after a volume of solvent of approximately 1.25 ml. This interesting plateau effect has appeared with varying volume of solvent for all varieties of solvents used in these laboratories, just as in all cases the time of solution approaches zero with decreasing volume of solvent.

TABLE I

Purification Stage	*Average "T" (12 observations)*	*"T" extremes*	*% error*
As Isolated	—0.72	—0.25; —1.01	34.1
First recrystallization	—0.95	—0.84; —1.09	9.8
Second recrystallization	—1.05	—0.99; —1.10	4.0
Third recrystallization	—1.11	—1.08; —1.13	1.8
Fourth recrystallization	—1.12	—1.10; —1.13	1.7
First resublimation	—1.12	—1.11; —1.13	0.9
Second resublimation	—1.122	—1.12; —1.13	0.7

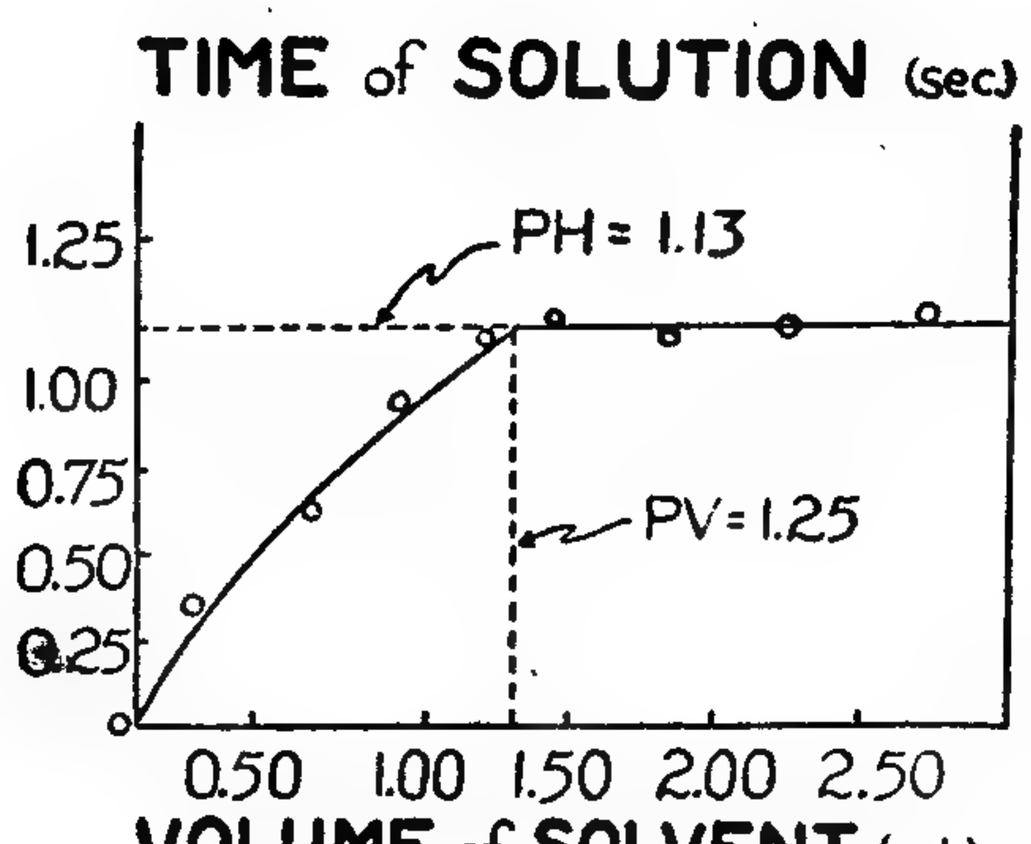


Fig 1

Time of Solution and Concentration of a Given Ion—In Figure 2, the results are given of the effect of the time of solution (T) of varying the volume of solvent, where the solvent consists of varying concentrations of sodium chloride solution. It can be seen that although in each case, the volume at which this plateau is reached differs markedly with the concentration, the heights of the plateau are constant (i.e. —1.13). The volume at which it is reached, hereinafter termed the Plateau Volume (PV), decreases

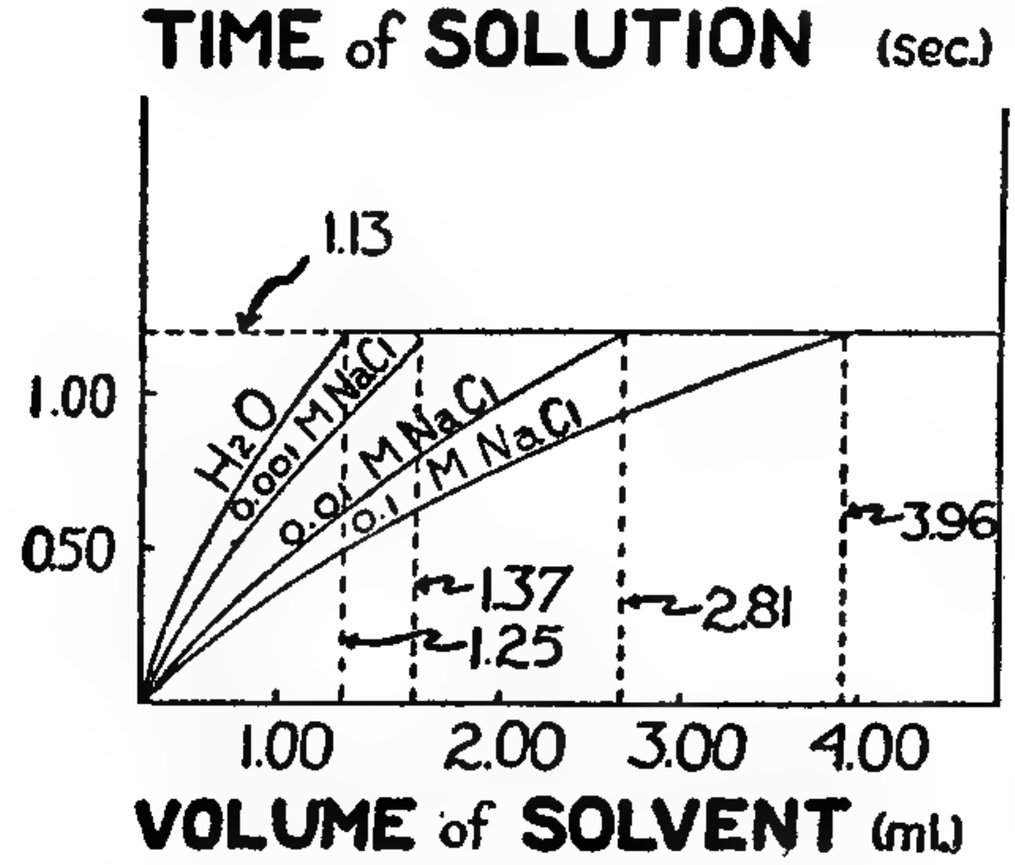


Fig. 2

with decreasing concentration of sodium chloride, approaching the PV for water as the NaCl concentration approaches zero. It is, therefore, obvious that a sodium chloride solution of unknown concentration can be quite accurately characterized by the determination of its PV, where other salts are absent.

This usefulness of PV extends to other ions as well. Figure 3 gives the endochronic curves for 0.001 molar solutions of sodium chloride,

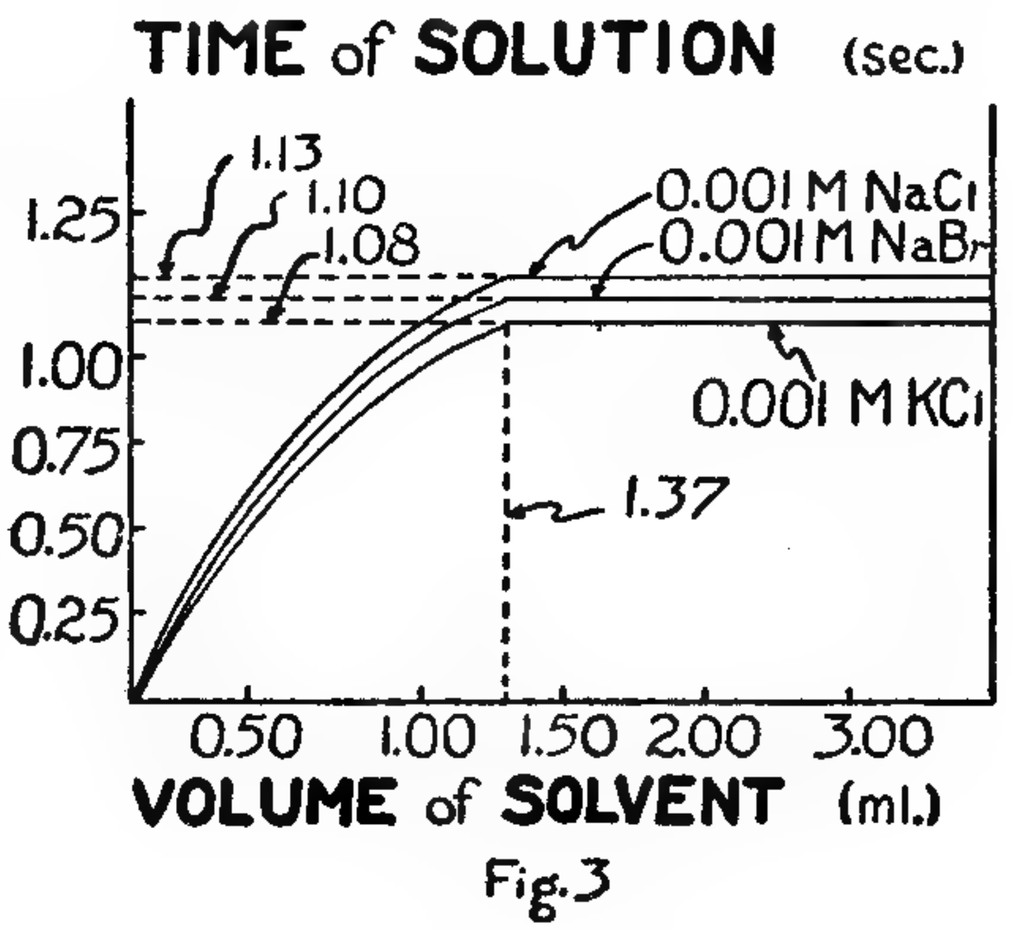


Fig.3

sodium bromide, and potassium chloride. Here, the PV in each case is equal within the limits of experimental error—since the concentrations in each case are equal—but the Plateau Heights (PH) *are* different.

A tentative conclusion that might be reached from this experimental data is that the PH is characteristic of the nature of the ions present in solution whereas the PV is characteristic of the concentration of these ions. Table II gives the values of Plateau Height and Plateau Vol-

ume for a wide variety of salts in equal concentrations, when present alone.

The most interesting variation to be noted in Table II is that of the PV with the valence type of the salt present. In the case of salts containing pairs of singly-charged ions --i.e. sodium chloride, potassium chloride, and sodium bromide—the PV is constant for all. This holds also for those salts containing one singly charged ion and one doubly charged ion—i.e. sodium sulphate, calcium chloride, and magnesium chloride—where the PV, though equal among the three varies markedly from those of the first set. The PV is, therefore, apparently a function of the ionic strength of the solution.

This effect also exists in connection with the Plateau Height, though less regularly. In the case of singly charged ions, such as in the first three salts listed in Table II, the PH is fairly close to that of water itself. It falls considerably where doubly charged ions, such as sulphate or calcium are present. And when the triply charged phosphate ion or ferric ion is present, the value sinks to merely a quarter of its value in water.

Time of Solution and Mixtures of Ions—Experiments currently in progress in these laboratories are concerned with the extremely important question of the variation of these endochronic properties of thiotimoline in the presence of mixtures of ions. The state of our data at present does not warrant very general conclusions, but even our preliminary work gives hope of the further development of the endochronic methods of analysis. Thus, in Figure 4, we have the endochronic curve where a mixture of 0.001M Sodium Chloride and 0.001 Ferric Chloride solutions is the solvent. Here, two sharp changes in slope can be seen: the first at a solution time of —0.29, and the second at —1.13, these being the PH's characteristic of Ferric Chloride and Sodium Chloride respectively—see

TABLE II

Solvent (Salt solutions in 0.001 M concentration)	*Plateau Height (PH) seconds*	*Plateau Volume (PV) milliliters*
Water	—1.13	1.25
Sodium Chloride solution	—1.13	1.37
Sodium Bromide solution	—1.10	1.37
Potassium Chloride solution	—1.08	1.37
Sodium Sulphate solution	—0.72	1.59
Calcium Chloride solution	—0.96	1.58
Magnesium Chloride solution	—0.85	1.59
Calcium Sulphate solution	—0.61	1.72
Sodium Phosphate solution	—0.32	1.97
Ferric Chloride solution	—0.29	1.99

Table II. The PH for a given salt would thus appear not to be affected by the presence of other salts.

This is definitely not the case, however, for the PV, and it is to a quantitative elucidation of the variation of PV with impurities in the solvent that our major efforts are now directed.

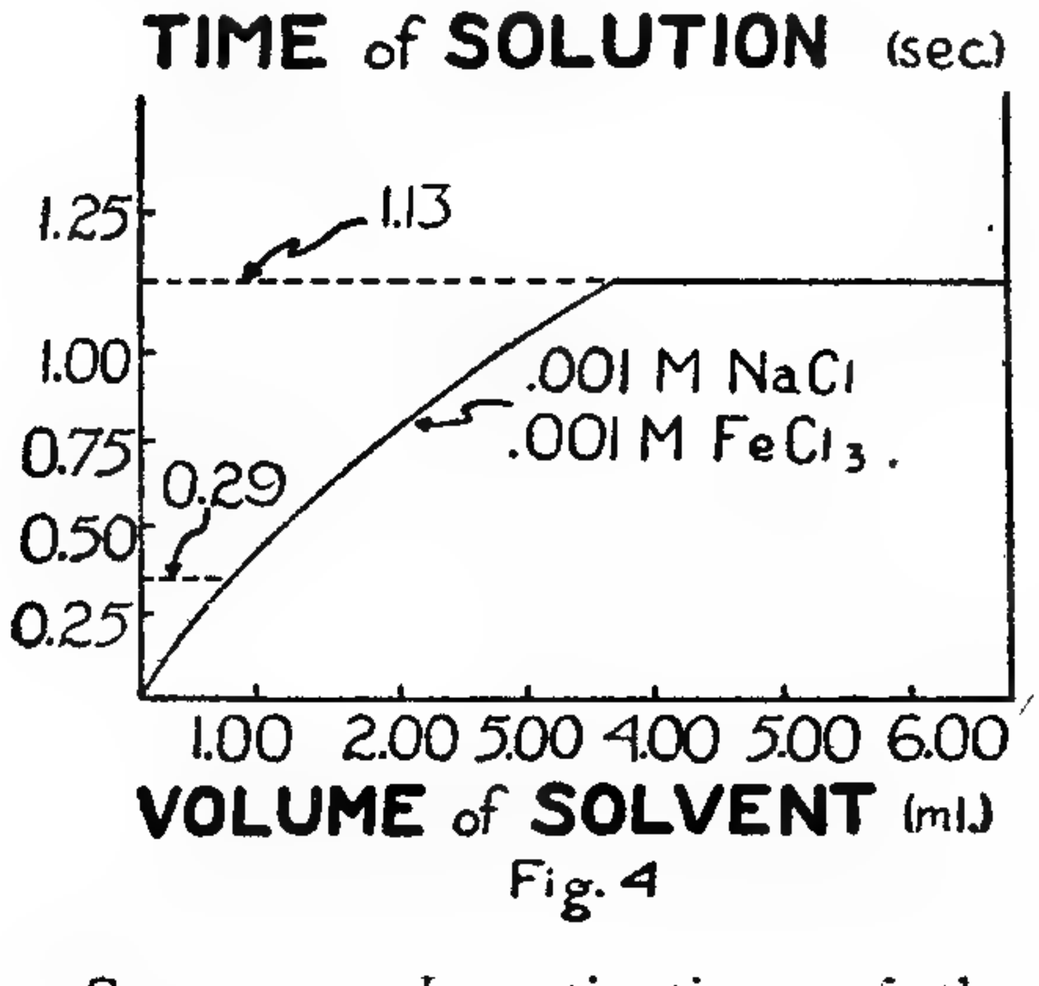


Fig. 4

Summary—Investigations of the endochronic qualities of thiotimoline have shown that:

a—Careful purification of the material is necessary for obtaining quantitative results.

b—Increasing the volume of solvent results in increasing the negative time of solution to a constant value known as the Plateau Height (PH), at a volume of solvent known as the Plateau Volume (PV).

c—The value of the PH is characteristic of the nature of the ions present in the solvent, varying with the ionic strength of the solution and not varying with the addition of other ions.

d—The value of the PV is characteristic of the concentration of the ions present in the solvent, being constant for different ions in solution of equal ionic strength, but varying markedly with the admixtures of second varieties of ions.

As a result of all this, it is suggested that endochronic methods offer a means of rapid—2 minutes or less—and accurate—within 0.1% at least—analysis of inorganic, water-soluble materials.

Bibliography:

P. Krum and L. Eshkin, *Journal of Chemical Solubilities, 27,* 109-114 (1944). "Concerning the Anomalous Solubility of Thiotimoline."

E. J. Feinschreiber and Y. Hravlek, *Journal of Chemical Solubilities, 22,* 57-68 (1939), "Solubility Speeds and Hydrophilic Groupings."

P. Krum, L. Eshkin, and O. Nile, *Annals of Synthetic Chemistry, 115,* 1122-1145; 1208-1215 (1945), "Structure of Thiotimoline, Parts I & II."

G. H. Freudler, *Journal of Psychochemistry, 2,* 476-488 (1945), "Initiative and Determination: Are They Influenced by Diet?—As tested by Thiotimoline solubility Experiments."

E. Harley-Short, *Philosophical Proceedings & Reviews, 15,* 125-197 (1946). "Determinism and Free-Will. The Application of Thiotimoline Solubility to Marxian Dialectic."

P. Krum, "*Journal of Chemical Solubilities, 29,* 818-819 (1946), "A Device for the Quantitative Measurement of Thiotimoline Solubility Speed."

A. Roundin, B. Lev, and Y. J. Prutt, *Proceedings of the Socicty of Plant Chemistry, 80,* 11-18 (1930). "Natural Products isolated from shrubs of the genus *Rosacea.*"

Tiotimolin kak Ispitatel Marksciiskoy dilektiki B. Kreschiatika, *Journal Naouki i Sovetskoy Ticorii* Vol. 11, No. 3.

Philossophia Neopredelennosti i Tiotimolin, Molvinski Pogost i Z. Brikalo, *Mir i Kultura* Vol. 2, No. 31.

THE END.

HER MAJESTY'S ABERRATION

BY RENÉ LAFAYETTE

Illustrated by Edd Cartier

Ol' Doc Methuselah *well knew the terror and misery a disordered mind could cause—particularly when the mind was that of an absolute ruler. And he also knew that many a deranged mind can be cured by surgery—surgery that has nothing to do with the brain!*

There is a slight disadvantage in being absent-minded. It was this regrettable failing which took Ole Doc Methuselah, highly respected member of the Universal Medical Society, some forty-five light-years out of his way and caused him to land in the Algol System on the planet Dorcon.

Hypocrates had asked him, pointedly and repeatedly if they had taken aboard a new pile at Spico and Ole Doc had answered him abstractedly in the affirmative. But it developed, some ninety light-years out, that they were traveling on the ship's reputation and that the poor old *Morgue* had but three or four grasshopper power left in her gleaming, golden tubes.

This was annoying. Hypocrates said so and, waving his four short arms, repeated, phonograph-record-wise, a two hundred thousand word text on fuels and their necessity in space travel. He repeated it so shrilly that Ole Doc in the pilot compartment unhooked every means of communication with the operating room where Hypocrates was delivering his secondhand oration and then used inertia converters to get down, somehow, into the Spico System.

He had never been there before, which was odd because it was not too distant from Earth—on the same side of the Earth Galactic Wheel, in fact. He had heard several things about it, now and then, for a man hears quite a bit when he has lived some seven hundred and fifty years. Somewhere near the beginning of that span he had jettisoned most su-

EDD
CARTIER

perstition and thus it had not been this which prevented him, though it well might have been.

Algol had a rotten reputation around the space ports. For some thousands of years men had been looking at it and shuddering only because it winked every three days. They called it the "Evil Eye" and the "Demon Star" and so deep was the feeling that for a century or more after space travel and colonization had begun people had left Algol alone, not even informing themselves if she had planets.

The wise knew she was a dark star rotating around a bright one, which accounted for her being a variable, but when an expedition crashed on one of her planets, when the first colony vanished, when a transgalactic flyer burned in the system, people began to recall her original reputation and shun her. That, of course, made her an excellent pirate base and all six of her variously inhabitable planets were soon messed about with blood and broken loot.

As is natural in such evolutions, she ultimately gave birth—it said in the "United Planets Vacugraphic Office Star Pilot" which Ole Doc was reading—to a strong ruler who ate up the lesser ones and for the past three hundred and nineteen years had been getting along as a monarchy of six planetic states governed from Dorcon. It said in the book that there were spaceship ways and limited repair facilities, fuel and supplies to be had at Ringo, Dorcon's chief city. Certainly they would have so small a thing as a pile there.

Ole Doc started to open the switch to tell Hypocrates where they were going but received a flood instead:

"'The manual circuits must be supplied by auxiliary hanbits of torque compensated valadium. Five erg seconds of injected . . .'"

Plainly Hypocrates was not pleased. Ole Doc laughed uncomfortably. He had picked the weird little creature up at an auction a century back, meaning to examine his metabolism which was gypsum but the gnome had been so willing and his brain was so accurately gauged to remembering that somehow Ole Doc had never thought again about examinations but had succumbed to these deluges of being informed.

A gong rang. A whistle blew. A big plate before him began to flick-flick-flick as it displayed likely landing spots one after another. A metal finger jutted suddenly from the gravity meter and touched off the proximity coil. The ship went on to chemical brakes. The cockpit turned at right angles to ease the deceleration of the last few hundred miles and then there was a slight bump. The *Morgue* had sat down. There was a clang inside as her safety doors slid open again, a tinkle of ladders dropping and a *click-click-click* as instruments dusted themselves and put themselves out of sight in the bulkheads.

Ole Doc unbuckled his crash helmet and stood up, stretching. The port guards were sliding open

of themselves, displaying a green expanse of field, a surrounding regiment of trees and the plastic towers of a city beyond.

But the instruments were not yet through. The analyzer came out, a square massed solid in red and green bulbs which recorded the presence of anything harmful, unnatural or hostile. And while it said green to atmosphere, gravity, vegetation, food, habitations, the weather, storms, the surface temperature, the sub-surface temperature, radioactive presences and a thousand others, it said red-red-red to soldiers, weapons, dead men, women and hostility. The strip at the bottom of the board read: "Relatively unsafe. Recommend take-off."

Ole Doc owed his continued presence in the flesh to a certain superstition about instruments. If they were there, they should be observed, and, if they gave advice, it should be taken. And he was about to take off on chemical and go elsewhere nearby when Hypocrates thrust his outraged antennae into the compartment.

"'. . . momentary inattention to fissure temperatures may result in ionization of farundium particles and consequent—'"

"STOP IT!" said Ole Doc.

Hypocrates stopped. But not because he was told. He was reading "Relatively unsafe. Recommend take-off." This gave him an impasse and while his dissertation struggled fiercely with this check, Ole Doc dropped down into his dining salon and drank the milk which waited there for him.

The ports were all open there, for the salon was beautifully designed, done by Siraglio shortly after the turn of the century, paneled in gold and obsidian and exquisitely muraled with an infinity of feasting scenes which, together, blended into a large star map of the Earth Galaxy as it had been known in his time. The ports were so designed as to permit scenery to become a portion of the mural without ruining it. But in this case the scenery did not co-operate.

Six hundred and nineteen dead men swung from the limbs of the landing field trees. They were in uniforms bleached by suns and snows and their features were mostly ragged teeth and yellow bone. The blasts of the *Morgue's* landing had made a wind in which they swung, idly, indolently as though in their timeless way they waltzed and spun to an unheard dirge.

Ole Doc set down the milk. He looked from flowering beds, well groomed grass, splendid walks back to the hanging dead.

"Hypocrates!"

The gnome was there instantly, all five hundred pounds of him.

"Stand by the ship. If anyone approaches her but myself, turn on Force Screen Alpha. Keep in communication with me and the ship in readiness to blast. Questions?"

Hypocrates was too thwarted to reply and Ole Doc changed into a golden tunic, threw a sun-fiber cloak about his shoulders, buckled twin blasters around his waist and stepped down the ladder to the ground

A man develops, after a few score years, certain sensitivities which are not necessarily recognized as senses. Carrying on the business of the Universal Medical Society was apt to quicken them. For though the members of the society possessed amongst them the monopoly of all medical knowledge forbidden by the various systems and states and although they had no sovereign and were inviolate, things happen. Yes, things happen. More than an hundred ebony coffins lay in the little chapel of their far off base—Soldiers of Light who had come home forever.

He directed, therefore, his entire energy to getting a pile and escaping Ringo within the hour if possible. And, guided by the sound of repair arcs and hammers, promptly brought himself to the sub-surface shops beside the hangars of the field.

And at the door he halted in stupefied amazement.

There were ten or twelve mechanics there and they did mechanics' work—but they were shackled one to the next by long, tangling strands of plastiron which was electrically belled every few yards to warn of its breaking. And overseeing them was not the usual super-educated artisan-engineer but a dough-faced guard of bovine attention to the surroundings.

Ole Doc would have backed out to look for the supply office, but the guard instantly hailed him.

"Stand where you be, you!" He advanced, machine blaster at ready and finger on trigger. "Hey, Eddy! Sound it!" A gong struck hysterically somewhere in the dark metallic depths of the place.

It was a toss-up whether Ole Doc drew and fired or stood and explained. But an instant later a barrel was digging a hole in his back.

Now if the president of the Vega Confederation had been so greeted by his lackey, he could not have been more amazed than Ole Doc. For though he was occasionally offered violence, he was almost never accosted in terms of ignorance. For who did not know of the Soldiers of Light, the Ageless Ones who ordered kings?

This pair, obviously.

They were animals, nothing more. Mongrels of Earth and Scorpon stalk, both bearing the brands of prisons on their faces.

"He ain't got a chain," said Eddy.

"Must've landed," hazarded the guard, straining his intellect.

"If you will please—" began Ole Doc.

"They'll be here in a minute, bud," said Eddy, planting his thick boots squarely in Ole Doc's path. He reeked of Old Space Ranger and was obviously a victim of an unmentionable illness.

They were there in less than that. An entire squad sled of them, complete with dirty uniforms, unshaven faces, yellow eyes and shiny weapons.

"Get in, pal," said Eddy, disarming Doc with a yank.

"Ain't he pretty, though," said a young corporal.

"Get in!" insisted Eddy.

Ole Doc saw no sense in a chance killing. It was not that serious yet. People weren't entirely stupid on Dorcon. They couldn't be!

He mounted the sled which promptly soared off toward the city, ten feet above the ground and traveling erratically. In the glimpse he had of the blue-green pavements and yellow houses of the suburbs, Ole Doc was aware of neglect and misery. A number of these inhabitants were evidently of Mongolian origin for the architecture had that atmosphere, but now the once-gay pagodas looked more like tombs, their walled gardens gone to ruin, their stunted trees straggling out from broken bonds. The desolation was heightened by the hobbling gait of a few ancient inhabitants who dodged in fear below the sled. It shocked Ole Doc to see that each was chained to a round ball.

The sled swept on toward the blue towers, but, as it neared, the first illusion of palace gave way to a gray atmosphere of prison. For the government buildings were all inclosed within many walls, each complete in its defenses, each manned like some penitentiary on Earth. Here was prison within prison within prison. Or defense within defense within defense. And the central portion, instead of being a courtyard and keep, was a metal roofed dome, wholly bomb proof.

But the sled had no business within. It bounced to a landing outside the guard house of the first walls and there Ole Doc was thrust into the presence of a dissolute young man.

Tunic collar unbuttoned to show a dirty neck, greasy hair awry, he sat with heels amongst the glasses and bottles on his desk. Obviously he was of that decayed school which thought that to be dashing one must be drunk.

"Where's identity card?" he hiccupped.

Ole Doc, naturally, had no such thing. But the rayed gold medallion around his neck was a passport to the greatest kingdoms in the universe.

"What's that?" said the young officer.

"My identification," said Ole Doc. "I am a member of the Universal Medical Society."

"The what?"

"I am a physician," said Ole Doc patiently.

The young man thereupon altered. He looked bright and interested. He brought his feet down off the desk, upsetting several glasses and bottles and snatched up an antique gadget Doc recognized dimly as a telephone.

"I got a doctor out here, Sir Pudno. How do you like that, huh? . . . Sure he looks like one. Why do you think I'd say so? . . . O.K., Sir Pudno. Right away."

In the wake of the reeling young officer Ole Doc was then delivered through eighteen separate ramparts, each gated, each guarded, until he came at last to a stairway which led underground. The officer having navigated this without falling. Ole Doc was ushered—or rather shoved—into a chamber done in blue silk, a particularly gloomy place which had for furniture but one bed and one chair.

Sir Pudno was getting out of bed.

He was a flabby, fat Mongolian of no definite features. He rolled himself up in a food-spattered dressing gown, sat soddenly in the chair and stared at Ole Doc.

"You really a doctor, Mac?" said Sir Pudno.

"I am. If you have some one to be treated, I shall be happy to oblige you. However there is a matter of a pile I need. I landed here—"

"Clam it, Mac," said Sir Pudno. "We'll go right up to Her Majesty."

He tucked his fat into a seam-strained uniform and then Doc was thrust after him into a chamber which was more like a powder magazine than a throne room. It was huge and once it had been pretty. But all the murals and mirrors had been removed and in their places were sheets of steel. No sunlight entered here and the pale blue gleam of lamps thickened the gloom.

The dais was thickly curtained and into the curtains had been set the kind of glass which admits light and therefore sight only one way. Someone or something sat behind on a throne.

Sir Pudno saluted and bowed: "Your Majesty, by great good luck I've been able to get a doctor up here."

"At how much cut of his fee?" said the person behind the curtain. The voice was rasping. Her Majesty was in no good mood.

"There's been no conversation of fee, your majesty," said Ole Doc. "Nor has there been any talk of services. I am a member of the Universal Medical Society and must not be detained. If you have a patient, I will do what I can without fee other than a pile for my ship. I repeat that I must not be delayed."

"He talks like he thinks he's somebody," said the person behind the curtains. "Well, show him the young fool. And remember this, you. Cure him but not too well. What did you say you were a member of?"

"The Universal Medical Society," said Ole Doc. "We do not like governments which detain our members."

"You know your business, huh?" said Her Majesty.

"People think so," said Ole Doc. "Now take me to the patient. I have no time to waste."

"You treat crazy people, too?" said Her Majesty.

"I have been known to do so," said Ole Doc, looking fixedly at the curtain.

"You seem to be pretty young. Curly hair and pink cheeks. Would you know how to make somebody crazy, now?"

"Perhaps."

"Build a machine or something to make people crazy?" she persisted.

"That is possible. Sometimes machines aren't necessary."

"Oh yes they are. I'd pay you well if you did it."

"What?"

"Made somebody crazy," said Her Majesty behind the curtain.

"This is out of my line," said Ole Doc.

"Well, show him to the patient anyway," said Her Majesty.

It was a tortuous way Sir Pudno led them. Urging Ole Doc on ahead of him and followed by an escort of twenty guards, Sir Pudno finally brought them to a chamber some two hundred feet into the earth. It was barred and sealed and guarded in three separate depths but opened at last into a mean, damp cubicle which stank of unwashed flesh and rotting straw.

They thrust Ole Doc into the darkness with a shove which sent him against the stone wall stunning him slightly and in that instant took away his kit and belt radio. The barriers clanged grimly behind him and left him ruefully rubbing his scalp in the fetid gloom.

Ole Doc pulled the tie string of his cloak and a small spotlight, which served ordinarily as a button, lighted and, when readjusted, spread a conical shaft into the mote-filled chamber. The circle lighted upon a young woman who clung to the far wall, fending the glare from the eyes of a small child in her arms. She was dressed in ragged finery, pale and soiled from long imprisonment, but humility she had not yet been taught. Chin up and nostrils flaring, she glared back at the light.

Turning, Ole Doc let the beam play over the remainder of this tiny cubicle and brought it to rest on the man.

He lay in dirty straw, face hidden by his arm. His fine, frilled shirt was ripped, his scarlet sash was blackened with grime, his trousers and small boots were white dusted and flecked with straw. Ole Doc moved a step toward him and found the woman interposed.

"You shan't touch him!"

Gently, Ole Doc removed her hand from his cloak. "I am a physician. They have permitted me to come here, saying that he is ill."

Half doubting she let him come nearer. He took a second button from his cloak and set it on a stone ledge where it shed a bright light over the recumbent young man.

The bright, hectic spots in his cheeks, the rattle in his lungs, the odor of him and the wasted condition of his hands cried tuberculosis to Ole Doc—and in the last stages.

He had not seen an advanced case of the disease for more than two hundred years and it was with great shock that he plumbed the ignorance of these people.

"This is dangerous!" he said. "A child in here with this. No care, no understanding. Woman, how long have you been here?"

She was protecting her eyes from the light but she raised them now, proud of her endurance. "Six orbits. My child is three."

"And they permitted—" Ole Doc was angry. He had not seen brutality such as this for a long, long time. For these people were not criminals. The woman and the man both looked high born.

"Who are you?" demanded Ole Doc.

"This is Rudolf, uncrowned king of Greater Algol. I am his queen, Ayilt."

"Then," said Ole Doc, a little amazed to find himself not proof

against surprises, "who is that who reigns?"

"His mother, the wife of Conore, dead six orbits gone."

Ole Doc glanced back at the doors. He was wondering how dangerous it might be to know too much about this. And then he decided, after one glance at the frightened child. "Start at the beginning."

"You are a stranger to all these planets, that I see well," said Ayilt, seating herself on the straw. "We know almost as little about the rest of space, for we are not rich nor brilliant and our planets are small, arid things, mostly stone with little land to till. And so I do not wonder that we are forgotten.

"We came from pirate stock—

not the best to be sure. And the mainstay of our population had been the terrestrial oriental who can live anywhere.

"Even so we had a happy government. There was not much. The last of the great revolutions was more than two hundred years ago and after that his family"—and she indicated the feverish, tossing boy on the straw—"stabilized the government. King Conore ruled justly and wisely and was much beloved by everyone. Since the beginning, because of our pirate origin, we discouraged traffic with space and it was well, for we had white and Scorpon stock and, outcast as it was, it often went bad. We had many prison colonies, but little crime. King Conore, like his forebears, was kind to prisoners. He gave them their chance in their own society and though he would not let them return to our worlds, they prospered in their way. But the terrible error was the sentencing of women to these colonies for women, I am ashamed to say, often descend from criminal stock as criminals. And so it was that our prison settlement population was large.

"We considered prisoners hopeless. We took away promising young. We hoped that these eugenics would serve us, and perhaps eventually wipe away all traces of our shameful origin. But now and then we erred.

"Yes, we erred. King Conore took a royal princess of the Olin line to wed, forgetting she had been born in a prison settlement for she had been removed at the age of four and was a brilliant woman and beautiful.

"They reigned well and wisely until there came a day when new pirates came. No one knows from whence they came nor why but they were not of this system. They are all dead now but it was said that the leader was terrestrial.

"Unsuspected they raised revolt among our Mongolians and then struck the blow themselves. During a pageant given in honor of my husband and myself, to celebrate our marriage, the rebels threw a bomb into the royal car.

"King Conore was killed outright. His wife Pauma was seriously injured about the face and was blinded in one eye. Palace guards were prompt but not quick enough to prevent the bomb. She had them hanged, six hundred and more of them. She butchered the royal servants. She cast my husband and myself into this hole. She tried and tortured to death in all more than a million people on the six planets and then the stomachs of all decent folk turned and they tried to smash her.

"We had forgotten her origin. We had forgotten the bitterness of a beautiful woman turned ugly. We had forgotten the prison settlements.

"We were set upon by convicts—or rather the planets were for my husband and I were imprisoned here. The army, all guards, all important dignitaries were killed or disbanded by Pauma's treachery and the convicts were set in their places.

"Unlettered, revengeful, wicked, the freed prisoners began to wreck the people and the land. And they

could do this for there was one convict for every three people on our planets.

"My husband and I owe our continued lives to the fear of Pauma that some other of our planets may revolt for there is hope everywhere that my husband still may arise from this tomb and govern as did his father."

"She keeps her own son here, then," said Ole Doc.

"Why not, doctor? He opposed her first measures, trying to point out that it was exterior influence which caused the tragedy. But she was always jealous of Rudolf for after his birth his father made too much of him and often at Pauma's expense.

"Royal line or not, Pauma was a gutter urchin. A prison settlement child. She told Rudolf that he meant to depose her and kill her. But she has to keep him here. While he lives no one dares raise a hand against Pauma for she has often threatened to execute him if this is so and then would ensue nothing but night for all Algol.

"This is why you find us here, doctor. Can you please do something for my husband? He has some fever or other and has not talked for days for when he talks he spits blood. See, the straw is spattered with it."

"We'll see what can be done," said Old Doc. And he called harshly for the guards and demanded that they return his kit.

Sir Pudno, outside the three barriers, argued about it. He conceived it to be full of weapons and like no doctor's kit he had ever seen. But when Ole Doc finally threatened to do nothing, the kit was passed through.

From it, when he had increased the light on the ledge, Ole Doc took a small plate and placed it on the young man's chest. By moving it about he was able to examine the lungs in their entirety, the plate only covering some two square inches at a time. He shook his head. There was little left of the fellow. He should have been dead days back. But nothing amazed Ole Doc more than the tenacity of the human body in its cling to life.

On his ship he could have done much better but he knew he could not ask that these be removed there. For Ole Doc was working for more than the health of this young king.

He took a vial of mutated bacteria mold and thrust it between the youth's lips. There was no danger of choking him for the cheeks would absorb the entire dose.

Then Ole Doc gave his attention to the woman. He was amazed, when he passed the plate over her chest to find her in such good health. Her heart was strong, her lungs perfect. The only thing she suffered was malnutrition and this on a small scale.

The child was somewhat like the mother but there was a spot upon its lungs. It cried when Ole Doc made it take a vial and the woman looked dangerous as it protested.

"Now," said Ole Doc, "I would advise you to hold your nose. This does not smell good." And he took

a bomb the size of his thumb and exploded it against the floor. A dense white cloud, luminescent with ultraviolet light, sprang up and filled the chamber.

The guard without protested, opened up, rushed in and dragged Ole Doc out, thrusting blaster muzzles into his ribs. The door clanged and then the other two barriers shut. Ole Doc was hastened up the long passageway and pushed again into the throne room.

The curtains moved slightly. Now that he had some idea of what was behind them a chill came over the Soldier of Light. For it seemed that black rods of evil were thrusting out from it.

Sir Pudno saluted and bowed: "A treatment has been given, your majesty."

"Will he recover?" asked Pauma behind the curtains.

"No thanks to you," said Ole Doc. "The boy was nearly dead from a terrible infectious disease. I would not be surprised to find that many suffer from it right here in the palace."

There was silence and a chill amongst the guards. But a laugh came from behind the curtains.

"And if you are not interested in that," said Ole Doc, "you might be interested to learn that diseases are no respecters of rank and glory and that I scent yet another in this very room."

There was silence.

Finally the curtains moved a little. "What may it be?"

"It is known as schizophrenia," said Ole Doc, "dementia præcox with delusions of persecution. A very deadly thing, your majesty. It destroys both victim and executioner."

There was silence again. The silence of ignorance.

"It is a dreadful thing, born from psychic shock. I scent here a broken schizoid of the persecution type, a paranoiac as dangerous to herself as to those about her." Ole Doc thought he spoke plainly and for the life of him, after what he had witnessed below and seen outside, he could not have refrained from this. But plain as he thought it was, only some annoyed glimmering was transmitted.

"I think you mean to be insulting," came from the curtains.

"Far from it," said Ole Doc. "I only wish to help. I speak of a thing which I know. Here, I will show you."

He faced a guard and then as though he plucked it from the air, a small whirling disk spun brightly in Doc's hand. He held it under the soldier's nose and spoke in a fierce, rapid voice.

There had been a movement to stop him but the antics of the soldier an instant later startled the guards and Sir Pudno into activity. The small disk had vanished, seen by none except the soldier.

"Bow wow! Woof!" and on all four the soldier began to gallop around the room and sniff at boots.

Ole Doc turned to the dais. "You see, your majesty? The illness is contagious. By merely shoving at him the soldier becomes a dog."

There was fear and something

more behind the curtains. "Remove the guard immediately! Come, you doctor. Do others have this here? Tell me! Do others have this here?"

With something like disgust when he realized the mentalities with which he dealt, Ole Doc faced Sir Pudno.

"I see traces of it here."

"No!" bawled Sir Pudno, backing and stumbling.

But the disk appeared and Ole Doc's voice was harsh if almost unheard even by Sir Pudno.

"Woof! Bow wow!" said Sir Pudno and instantly began to gallop around the room.

There was fear in the place now. Ole Doc took two or three steps toward the guards who had remained and then, suddenly, they bolted.

There was a scream from behind the curtains and then terrified anger as she vainly sought to order them back.

Ole Doc was wary. He knew she must be armed. And he carefully halted ten paces from the curtains.

"I am sorry," he said soothingly. "I am very sorry to have had to disclose this to you. I know what you go through and what you have to face. Only an intelligent man would truly understand that. It must be terrible to be surrounded by such people and to know—"

And the little disk was spinning in his hand.

It does not take many years for a powerful personality to acquire the trick. Ole Doc, in a purely medical way, had been practicing it for the last seven hundred. One gets a certain facility that way. And the little disk spun.

There was a sigh behind the curtains. Ole Doc flung them back.

Had he not known the things she had done pity would have moved him now. For the sight he saw was horrible.

The bomb, six orbits ago, had left but little flesh and had blackened that.

He took a glass bomb from his kit and exploded it, carefully backing from the smoke. The narcotic would do what the disk had begun.

She must have spent all her hours behind that curtain for there was her bed, her few clothes, a small dresser. And on the dresser, where the mirror should have been, was a life-size painting of her as she had been in her youth.

Indeed she had been a lovely woman.

Ole Doc rummaged in his kit, sneezing a little as the narcotic fumes drifted his way, and finally located the essentials he needed.

The work did not take long for he had a catalyst. Sir Pudno was guarding the door and growling from time to time, but admitting no one.

Ole Doc ripped the finery from her and bared her back. His all-purpose knife, in his hands, was more than a sculptor's entire rack of tools. He looked from time to time at the life-size painting and then back to his task.

The catalyst went in with every thrust of the knife and before he

was finished with the back it had already begun to heal and would only slightly scar. The shiny grease was the very life of cells and hurled them into an orgy of production.

His surgery was not aseptic for it did not have to be. Before he was through he would guard against all that.

The work was long for the likeness must be good and the scar tissue was stubborn. And then there was the matter of cartilage which must be cut just so. And it took a while for the follicles of the eyelashes to set. And it required much care to restore activity to the eye nerves. But it was a masterful job. Ole Doc, three hours later, stood back and told himself so.

He gathered up the bloody sheets and thrust his patient into a sitting position on the chair. And all the while he was talking. Her eyes fixed on him now, absorbing every syllable he uttered, began slowly to clear.

Ole Doc had his eyes on the scars which soon ceased to be pink and then turned bone white. Finally they sank out of sight and something like circulation began to redden the cheeks.

It was time now to do other things.

Sir Pudno barked his compliance and went out to order workmen up and soon a stream of these, hampered by their chains until Ole Doc had them struck off, began to restore the mirrors and paintings to the walls. Other furniture soon appeared, a little frayed from years in storage but nevertheless very brightening. The lighting was altered. New clothes were issued.

Everytime anyone came in and demanded authority for orders such as the removal of the hanging dead at the landing field, Ole Doc had only to shove a hand inside the curtains and a signature came out.

Soon he was able to bring up the rightful king, his queen and prince and they came, blinking and dirty to be seized without explanation and rushed away. But as they were certain of death they were too stunned to protest. They were washed and robed.

News was spreading. More and more people came until Ole Doc saw the entrance doors bulging. The corridors and courtyards were full. Rumors were flying from city to town, from planet to planet through the system.

Then Ole Doc stood the youth before him. Dressed, shaven, healthy, Rudolf bore little resemblance to the dying man in the hole a few hours before.

Rudolf would have had vast explanations.

But Ole Doc was terse. "You are going to take that throne in about five minutes and you are never going to mention a word of the last six orbits to your mother. I must have your word on that.

"You are going to retire her to a villa and keep her in luxury. Do I have your word?"

"Yes. Of course. But I—"

"You see that he does keep it," said Ole Doc to Ayilt.

"Never fear. We'll do whatever

you say. To think that only a few short hours ago Rudolf was dying—Truly, you must be an angel."

"Others think very differently, I fear," said Ole Doc with a grin. "Charge it up to the Soldiers of Light, the Universal Medical Society. And never breathe a word of how I've taken a hand in politics here. Now, any questions?"

They looked at him numbly but there was life and hope in them once more. "We have inherited a terrible job, but we'll do it," said Rudolf, pumping Ole Doc's hand.

Ole Doc had to restrain Ayilt from kneeling to him. Brusquely he placed the two of them on the old restored thrones and led Pauma out from the curtains which were now destroyed.

Pauma stood looking obediently at Ole Doc until, after a few swift words, he broke the spell.

It was their show then. King and queen on their thrones nodded graciously to the queen mother at her greeting but before they could speak more than a few words the great doors burst inwards and the place was flooded with people, commoners, burghers, soldiers come to know where they stood, and their mouths were full of fled garrisons and a populace burst from the bonds of slavery.

They didn't notice Ole Doc. He glanced at the old queen. She, too, had been thrust back but she was preening herself before a mirror, coquettishly turning her head this way and that to admire herself.

Shortly afterwards, in a commandeered sled, Ole Doc arrived at the supply sheds of the hangars. The place was deserted. Two guards were dead and shackles were scattered about, broken. But the supplies were all in order and Ole Doc carefully selected a small two-billion-foot thrust pile, pocketing it.

The light seemed brighter as he walked back to the field. Then it was clear why for the dark star had been quarter covering the bright one on his arrival and had now spun clear.

The trees around the field were free of any burden but green leaves, and the old *Morgue* gleamed golden in the pleasant expanse.

A moment after, Ole Doc stepped aboard.

Hypocrates was waiting peevishly. The little creature threw down the tome on stellar radiations he had been reading and began to shrilly berate his master for having taken so long.

"One would think piles were hard to get!" he complained.

"This one," said Ole Doc, "was."

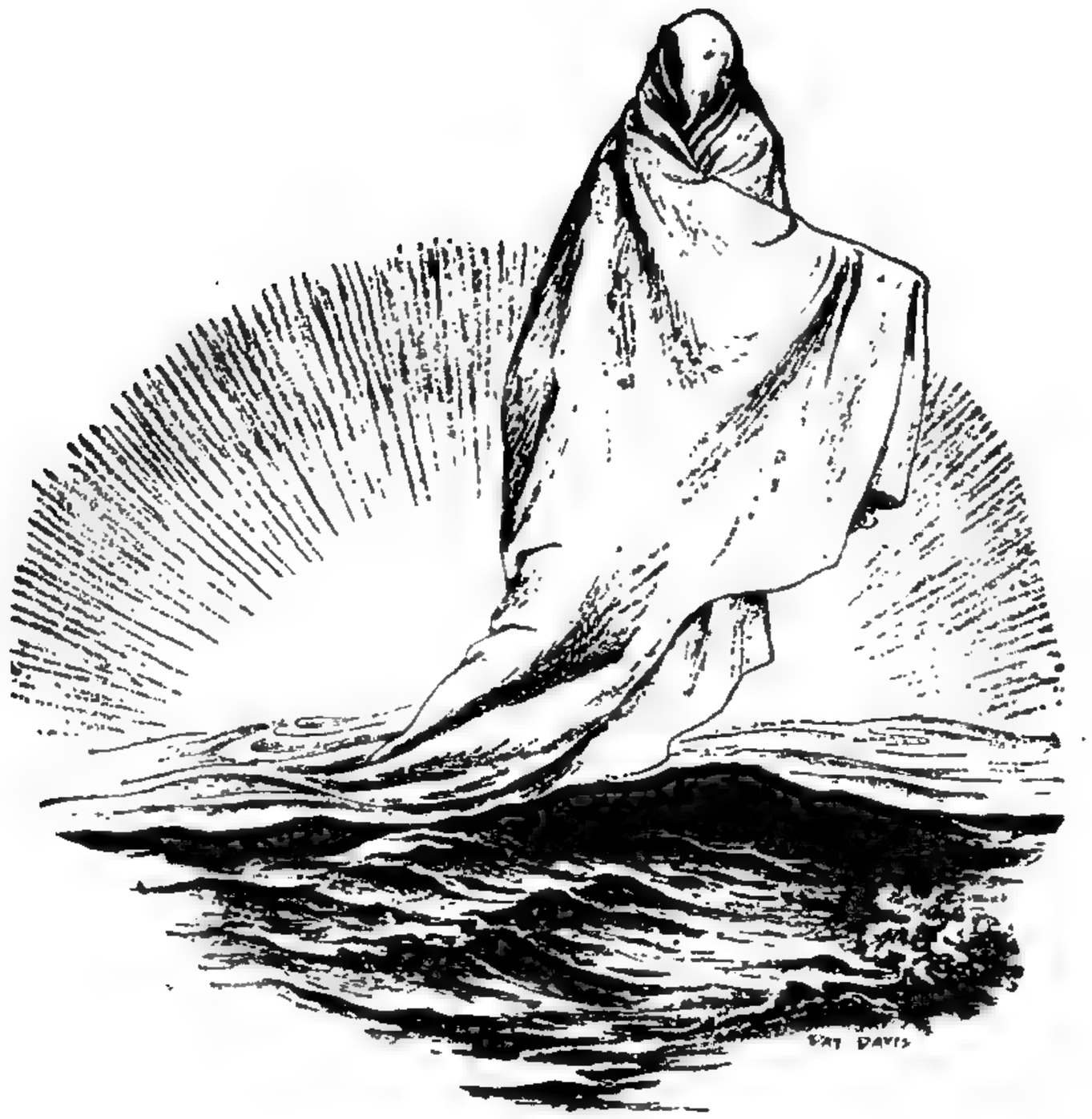
"Let's see it," said Hypocrates, not believing.

Ole Doc showed him and the little fellow was all smiles. He bounced below to install it, singing the ribald "Fiddler of Saphi" as he went.

Shortly after the *Morgue* was leaping out toward the hub and all was peace aboard her.

The pile was working perfectly.

THE END.



FILM OF DEATH

Water is enormously important to man—but the most important part of an ocean is the top ten thousandths of an inch!

BY J. SCOTT CAMPBELL

Illustrated by Pat Davis

Text of an address delivered before the Thirty-fifth Anniversary Banquet of the Federation of American Scientists, December 6, 1980.

Mr. Chairman, ladies and gentlemen:

We of the older generation hold somewhat of an advantage over most of the membership of this Association in that we have seen with our own eyes the tremendous events which transformed the world into what it is today. We recall as vivid reality what many of you know only as history. I am, therefore, sure that you are more interested in me as an eyewitness than as an astrophysicist of rather obscure reputation, and so I shall simply tell you, in my own words, and with the flavor of the times as far as I can, how these amazing and dramatic events took place.

It began, as you well know, in the

winter of 1949-50. I find difficulty in remembering just what I was doing then, but you will agree, I am sure, that this was the year when the great worry over the plutonium bomb, then called simply the Atomic Bomb, began to subside. The Atomic Development Authority had been finally set up; all bombs, and supplies of uranium, thorium and plutonium had been transferred to it, and all mines, piles and other dangerous facilities were out of nationalistic hands. Even the Soviet Union was happy, although there were plenty of critics of our part in the Iranian affair.

In the United States production was at last under way. Inflation had been checked, and food and steel were plentiful again. Strikes were still occurring, but these were regarded more as "after shocks" from the great upset, than as portents of troubles to come. In fact, for the first time in many decades, there were no ominous clouds on the horizon.

And yet the danger was there, hidden, disguised even from the men most intimately connected with it. Schneider, working patiently with his mass spectrograph in Chicago, laboriously piling up, atom by atom, the rare isotope 204 of lead. And Ordway, here at the Institute in the organic chemistry lab, mixing fatty acids and hydrocarbon chains, searching and searching.

Did he know what he was after? What would he have said, if someone had asked him? Well, I know, because I asked him.

It was during the Christmas recess of 1949. I had been doing some reading in the Chem Library, and dropped down to his lab to tempt him into a walk and a midnight cup of coffee. He wouldn't go, but we did talk a little about his work.

"It's an organic hydropolar acid," he explained. "It forms chain molecules having a preferential orientation with respect to water."

"What will you call it?" I asked.

"Well, it really can't be named yet, because I haven't actually found it," he admitted. "But when I do, it'll probably be"—he hesitated—"something like, well, zetylsulfonic acid."

"I see," I said hurriedly. "Z-acid for short, eh?"

Dr. Ordway nodded happily, evidently visualizing that monumental name as a title in Chemical Abstracts.

"But, what will it do?" I pursued. "That is, what are its properties?"

"I'm not sure yet, but I hope that it may have some practical value. You see, a hydropolar molecule attaches itself very closely to water. What I hope is, if I can get the structure just right, that it will form a thin film, a monomolecular film, which will lie over a water surface like a tough skin and prevent gas absorption, or evaporation, or any other transfer to or from the water."

I probably looked a little blank, for he hurried to explain further.

"That would lead to most important economic results. In chemical processes—oil refining or paper making, for example, or even on

reservoirs and irrigation ditches to prevent evaporation—Why, there's no limit to what it can do—that is, if I get it."

I thought he ended a little lamely, and so, as it was getting late, I said good night and headed for my own home and bed.

I think it was a month later that Dr. Ordway at last succeeded in synthesizing Z-acid. I say "think" because it was only a few days after this, on January 5, 1950, that Schneider announced the fission of lead, and after that, of course, everything else was forgotten.

The sensation created by the little red-headed physicist's discovery was simply beyond description. Of course, it could have been handled in a much less sensational way, but of all parties, Schneider was least to blame.

Dr. Schneider, you must understand, was both a cautious and a reticent man. He may have guessed the consequences of his work, but he wasn't going to go out on any limb until he was absolutely sure. He may also have been a little frightened by the notoriety which had plagued Oppenheimer since Los Alamos. And the ADA hog-tied by the absurd stipulation that fission could occur only in uranium, thorium and plutonium, did not check into his calculations at all.

In any case, he took some Lead 204, and a small amount of ordinary lead in a launch, anchored his experiment twenty miles out in Lake Michigan with a time clock, and then prudently retired near the shore to await results.

They were not long in coming. Schneider had never seen a plutonium bomb go off, but when he saw the enormous fireball, and the cloud of smoke and vapor which soon towered fifteen miles into the sky, he knew what he had.

He came fairly close to not knowing it for long, because his boat was nearly swamped by the tidal wave which presently came rolling over the horizon. The same wave crashed all along Chicago's waterfront, piling yachts in Grant Park, and inundating much of the loop district. Schneider, unable to find any trace of his own anchorage, waded ashore near the Planetarium and hailed a taxi.

By the time he reached his laboratory he was famous. The press met him at the front door, with an interview which is historic.

"Tell us, Dr. Schneider, was that a U-235, or a plutonium bomb?"

"Neither. It was lead."

"Lead? But lead is stable!" This from a graduate student in physics.

"It is stable," agreed the scientist, wet and confused, "until it is activated by emissions from Lead 204."

Pencils were going fast now. Perhaps Schneider thought it was a class, taking lecture notes.

"My bomb, if you so choose to call it, consisted of five hundred grams of ordinary lead. A half centimeter diameter hole was drilled into it, and in this was placed two milligrams of Lead 204, separated by means of a mass spectrograph from a sample enriched in the light-

er isotopes by the diffusion process. The Lead 204 was brought to a high temperature by means of an electric spark, starting a thermonuclear disintegration. Emission from this process, whose exact nature is rather complex, at once caused fission in the whole mass of lead—"

It was out, the damage had been done. The Chicago ADA representative, who was doing some fishing off the Florida coast, read about it in the Miami paper. What he said has not been recorded.

Within a day it was common knowledge throughout the world. At first the headlines were boasting: AMERICA DOES IT AGAIN! OUR LEADERSHIP IN NUCLEAR PHYSICS NOW UNQUESTIONED. Then the tone became frightened. ATOMIC WAR AGAIN A POSSIBILITY; LEAD BOMBS TERRIFY WORLD. And inaccurately, EVERY LEAD PENCIL A MENACE!

The Atomic Development Authority, and then the UN Security Council hurriedly met. Dr. Schneider was hauled on the carpet, where he dissolved into tears and remorse. The Council was at first in favor of trying him for international treason, and then it realized that more serious problems were at hand. The Soviet and Argentine representatives were called home for consultation. The headlines died down, but now throughout the world there was a mounting undercurrent of terror.

Uranium bombs had been bad enough, but they were nothing like this. Lead was plentiful, lead was cheap, and the deadly isotope could be extracted in sufficient quantities in any one of a hundred laboratories. No massive piles, no billion dollar factories were needed; just a pound or so of common lead, and a few months production from a mass spectrograph. Anyone could produce Lead 204, and with the process explained so lucidly by Dr. Schneider, anybody could, after a few months, start producing bombs. Big countries, little countries, political factions, crackpots, all were on a common footing now. The laboriously created balance of power, the careful treaties between nations, the endless compromises that had gone into the ADA, all were now futile.

Only a faint concept of the world's state of mind can be obtained by reading the old papers. Confusion, anger, fear seemed in the very air. The Russian press denounced America for loosing the devil. The American press accused the Soviets of turning a great peaceful discovery toward the path of war. And, at the same time, the press of both nations united in denouncing Schneider as a traitor to humanity. The poor physicist, crushed, was spirited away by some of his colleagues and for a time vanished from the sight of the world.

By the first of February the excitement had reached a crescendo of debate and accusation. Congress was in continuous session, the UN Security Council was deadlocked over control measures, and the American people were taking mat-

ters into their own hands, and moving out into the country.

It was about this time, I believe, that I met Dr. Ordway in front of the Chemistry Building. He seemed very pleased, which was enough, in those days, to startle me.

"Well, Ordway, what brings you out looking so satisfied?"

Tempers and courtesy were both a bit short at that time, but Ordway didn't seem to mind.

"Isn't it wonderful," he cried happily. "It's so easy to manufacture, we'll have tons of it in a few months!"

I blinked, completely off the track.

"Zetylsulfonic acid, of course," he explained. "It can be synthesized from oil refinery by-products. The Coast Oil Company is going to manufacture it for me, and we already have orders. Dear me, I fear that I am about to become rich! You know, they want to use it in Arizona and New Mexico to coat the water in irrigation reservoirs. It's very durable. If it isn't allowed to run off, it'll last for ten years. Why, it's even going abroad. The Iranian Soviet Republic had an order in for eight thousand tons, for evaporation control."

"Eight thousand tons," I started, still half thinking of lead.

"That's right. It's an enormous amount—thousands of times more than they need, but perhaps, with all this uncertainty in the world, they want to be provident."

I blinked a few times, and then steered the conversation to the subject of the bomb. Ordway knew very little about physics, and contented himself with a few generalized remarks to the effect that maybe scientists should take over the government.

During the next few months I lost track of Dr. Ordway and his marvelous Z-acid. Momentous things were happening in the world, and what time I had free from my own research and teaching was mostly consumed in speaking and writing in behalf of the Federation of Scientists. We were making a last desperate effort to convince people that reason could prevail, and that even this terrible danger could be averted if men of good will got together and reasoned. I think we all knew, inwardly, that it was hopeless, but we kept it up during that long spring, while the lead stockpiles grew.

By June, when the clear sunny weather came to Southern California, and the beaches were crowded, a sort of uneasy hush descended over the press. Congress adjourned, with major accomplishment, while the members of the Security Council watched each other like wary dogs. Something was up, everyone knew, but what, or where, could not be guessed. There was an unusual number of summer visitors to the mountain areas around Los Angeles; everyone, it seemed, wanted to get away from the congested cities.

Even the faculty seemed infected by the fever. I was standing in my office counting days on the calendar until the end of finals, when the door opened to admit Dr. Ordway.

I turned to him with relief, for

his pleasant disposition was very cheering, and then I gasped with surprise. It wasn't the same Ordway. Gone was the smile. Instead his countenance was as haggard as that of a Security Council member. He appeared to have gone without sleep for days. Guiding him to a chair, I asked in amazement: "Fred, what's the matter? What's happened?"

In reply, he mutely handed me a paper, and pointed to a small paragraph near the bottom of the front page. I read:

"Typhoon sinks tanker. The new Soviet Tanker *Vladimir Stuloff* reported by radio that it was broken in two and sinking five hundred miles east of Hokkaido, in the season's worst typhoon. The ship, normally used for gasoline transport, carried an eight-thousand-ton cargo of Z-acid, a new evaporation inhibitor developed by Dr. Frederick Ordway, well known chemist of . . ."

I looked up with understanding.

"Why, that's terrible, Fred. That must be your whole production. I suppose they won't pay for it, unless there's insurance."

"Pay—" Ordway looked blank. "Pay— Don't you realize what this means? I never should have allowed it. Eight thousand tons of Z-acid—"

With a shiver of premonition, I began to grasp what Ordway was driving at.

"Do you know how much Z-acid it takes to cover an acre of water?" he asked abruptly, and then answered the question himself. "It takes 0.0018 ounce. That means that one ounce will cover 556 acres, one pound will cover 13.9 square miles, one ton will cover 27,800 square miles. Eight thousand tons is enough to cover all the oceans of the world almost twice over. It will stop all evaporation, don't you see? The rivers and lakes will dry up, all vegetation will wither. It doesn't matter now whether we blow each other up or not. We'll all be dead anyway in three or four years."

I sat heavily on my chair, trying to reorient my thoughts. It was no use asking Fred if he had checked his figures. The black circles under his eyes attested to the time he had spent in that. And there was no use in asking whether his fundamental theory was sound. I knew Fred too well for that. He was a careful and thorough worker, and when he said that Z-acid would do certain things, that was final.

I think I just sat quietly for a minute and stared at him. Then—

"Have you told anyone else?"

He shook his head.

"Good. Above all, we don't want to repeat Schneider's performance. But we must notify the authorities. Z-acid is not permanent. If we start saving water and food right now—"

Ordway shook his head. "A single layer is good for ten years. With this dose, no one knows how long the sea will be covered—fifteen years, maybe twenty . . . I don't know."

I was struck by an idea. "Maybe we have some grace. You know, it can't cover the whole ocean instantly."

"It spreads fast. In a month it'll be all over the Pacific. By October it will reach the Cape of Good Hope, and by early next summer all of the Atlantic will be covered. No, we can't get away from it."

Well, as you know, Dr. Ordway and I notified the authorities. We started at what we considered to be the propel level, the Secretary General of the United Nations. We were unable to contact him. We tried the President, with the same results. Then, alarmed, we visited the President of the Institute, whom we convinced in short order. He telephoned the Army Chief of Staff, but the General was out of town. He told his story to a subordinate officer, who promised that it would be brought to the General's attention. We urged the utmost secrecy, but somehow the story leaked out. We had called Washington on a Friday. On Sunday the local paper carried an AP dispatch datelined Washington:

"Scientist states that the oceans will dry up as a result of the loss of a shipload of mysterious Z-acid—"

Sunday night Ordway was aboard a plane for Washington. I stayed home; I still had my examinations to give.

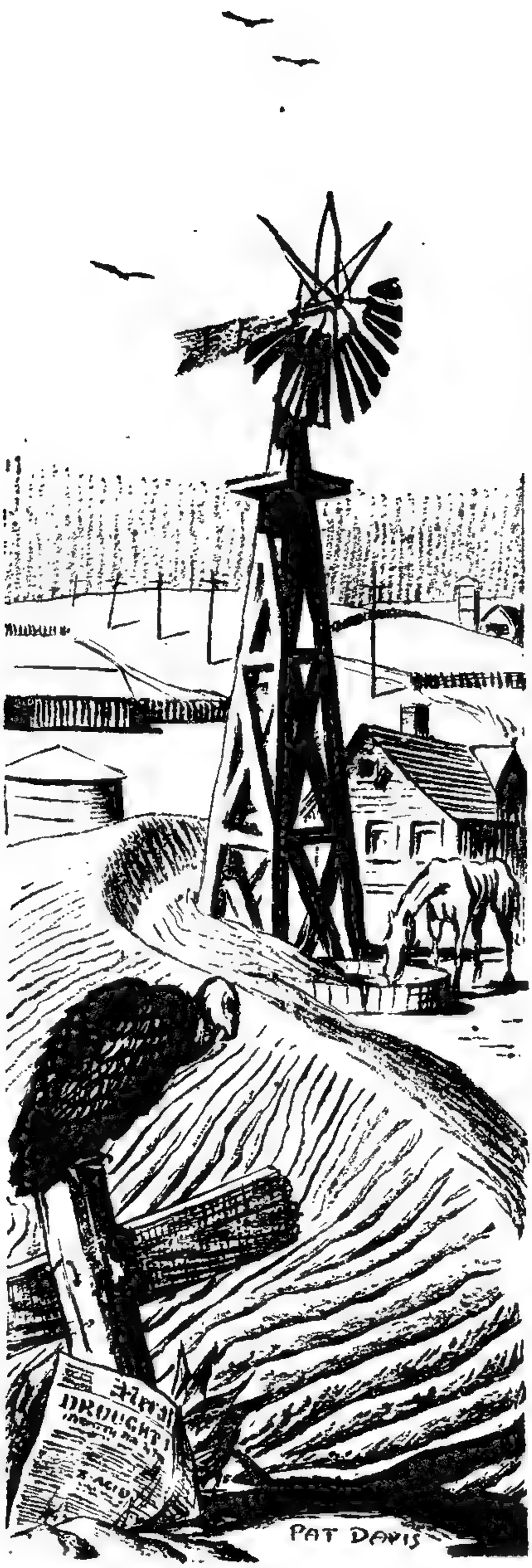
The transition of mass hysteria from one object to another which occurred in the next few days will probably occupy psychologists for many years. I was in a unique position. I knew in advance what was coming, and I started a clipping collection with that write-up of our first efforts as a warning.

At first the news was vague. I knew that Ordway was active, because his name kept appearing in news items connected with certain secret experiments and demonstrations. Once an army courier came to the Institute, and I arranged for him to secure a fifty-five gallon drum of Z-acid. I commenced watching the weather maps for the north Pacific, but saw nothing dramatic, such as a lifting of the Aleutian fogs.

Then, on June 22, 1950, a carefully worded announcement was carried by all papers:

"The President announced at 4:40 a.m. today that an unavoidable accident on the high seas has presented this nation and the world with a new situation holding the gravest dangers. There is no immediate risk, but the general public is urged to co-operate with the authorities in action directed toward the conservation of water—"

There followed a clear résumé of what had happened, in the unmistakable style of Dr. Ordway. It was pointed out that there would be no immediate change in climate. Billions of tons of water were already air-borne, and it would be many months before this vast burden would be squeezed from the atmosphere in the form of rain. Meanwhile conservation measures were put into effect. The spillways of the great irrigation dams were closed, and coffer dams were hurriedly erected along their crests to retain excess floodwater. The rapids above Niagara and at Sioux were blocked to retain the waters of



the Great Lakes, the largest reservoir of fresh water in the world. Earth dams were thrown across a thousand rivers and creeks, and even strings of empty tank cars were filled with water.

The public reacted with gusto. Here was no vague and distant threat about which they could do nothing, but a simple and real emergency, into which every man, woman and child could pitch. Cisterns, ponds, tanks, barrels and even kitchen utensils were filled with water and stored away. Z-acid itself was suddenly in tremendous demand, as a protective cover for the precious fresh water.

Abroad the reaction was the same. The foreign press thundered against American meddling, but all governments, large and small, went to work on the conservation program. The bomb vanished from papers and conversation, and with it went the war fever. Humanity bucked up its challenge, united as it had never been before.

As preparations for the drought continued during the summer, the first weather changes made themselves felt. At first they were merely statistical, and noted only by the meteorologists. A decrease in the percentage of foggy days along the southeast Alaska coast. An unseasonable cold dry wind blowing over Canada. In late August, a two-week period of clear weather at normally foggy Cape Flattery. Then, as the film spread over the whole north Pacific, the drought came. Over the Pacific Northwest there

spread a blue sky of incredible depth and clarity. Daily through September the sun grew warmer and the nights colder. Water vapor, the great heat regulator, was gone. At noon the merciless rays of the sun were unscreened, but after nightfall, there was no vapor blanket to hold the warmth in, and the temperature dropped as it formerly did only in deserts and on mountaintops.

The situation was soon mitigated in the northwest by the smoke from forest fires, which restored some of the temperature regulation.

In the dry southwest of the United States, the change was not serious until far into the winter. To be sure, San Francisco was for the first time without her famous fogs, but California, used to long dry summers, did not feel the pinch until the spring of 1951, when the snow runoff failed because there was no snow.

By this time the catastrophe had become world-wide. With the covering of the Indian Ocean, the torrential rains of the monsoon failed, and the jungles of southeast Asia sweltered and turned brown. Rivers and swamps vanished, and fierce head-hunters, in terror as elemental as that of the jungle animals, came down the dry stream beds until they reached the salty ocean.

The exact courses of the meteorological changes have been amply documented, and I shall not even attempt to trace their general outline. The western shores of the oceans were affected first, with the failure of the moist trade winds and cyclones. Oddly, normal rainfall continued in the eastern United States for months; only later was it realized how much water could be taken up from supposedly dry land.

During all of this time, of course, the program of conservation and utilization of water went forward. In the United States, the Great Lakes were the key source. Pumping stations were established to supply an intensive irrigation project for the raising of food. Had only the population of the central states been involved, this reservoir would have lasted for twenty years, but unfortunately, the Great Lakes were unique on earth. In Europe and Asia, and even in the American west, the local water supplies were nowhere near sufficient.

The first blow to the west came with the shutting off of all hydroelectric power. Overnight, Los Angeles was back in the gaslight era, with the closing down of Boulder Dam. The power output of available steam-generating plants was diverted to vital industrial uses. In a week, after a vain appeal for voluntary rationing of city water, the mains were shut off and water was delivered by tank truck. But, even with these desperate measures in force, people would slip out at night with a pail in the vain hope of keeping lawn or flowers alive. Illegal watering became a serious crime throughout the United States.

From the very start people were assured that they would not die of thirst. If drinking water was the only requirement, humanity could exist for centuries on the available

fresh water. The fatal lack was food—food which could only be raised with the aid of water.

I will not bore you with figures on the water consumption of various crops, nor with an account of the frantic research which was put under way to determine which crops required the least water. No matter how the figures were juggled, the answer always came out the same—death for most of the race in five years, by slow starvation.

It was at this point that the secret conferences began. No word of these was ever released to the press, but it got around. Humanity was doomed, but some might be saved. If the population were reduced to a tenth, that tenth could survive. But only if the reduction was made quickly. And so the fear of the bomb—Schneider's terrible discovery which had been completely forgotten—revived. Rumors spread malignantly through the hot dry spring of 1951. Soviet Russia was preparing to wipe out the population of America in one super raid, and then seize control of the Great Lakes. Meetings were called in Washington, under a tropic sun which raised day temperatures to 110 degrees, and in the depths of arctic nights which saw ponds frozen over in a few hours. Several times Dr. Schneider was seen hurrying in and out of the Pentagon. Obviously, something was up. America would strike first, would save herself by stopping the aggressor before he could strike.

And then the incredible happened. The President announced that a broadcast of "historic importance" would be made at 9 p.m. Eastern time, June 10, 1951. At that hour the greatest radio audience of all time assembled. Magically the lights of Los Angeles and other coast cities came on—under orders from Washington, the penstocks of Boulder Dam had been opened, and the great generators were again turning. Wondering, the people listened.

The broadcast proceeded without the formality and fanfare usual on such occasions. Obviously everyone in Washington was too tired for ceremony. An announcer stated: "Ladies and gentlemen, the President," and then the tired, familiar voice began, without even the usual "Fellow citizens."

"You have been very patient with us in these difficult times, and I am happy to say that a solution has been reached which will give all of us a good fighting chance to survive. This solution is not war. The heads of the governments of Britain, France, China and the Soviet Union are with me here today to co-ordinate work in their countries with us. The real hero of the occasion is also here today, and I shall let him explain the proposal he brought to us four weeks ago. I present Dr. Alexander Schneider."

Ordway and I were listening over the small radio in my office. I suppose our reactions were typical, for I recall that he exclaimed: "What, mass suicide by the lead bomb?" Then we listened. It was the first time I had ever heard the physicist.

His voice was high-pitched, uncertain, and seemed at times about. to break altogether. His delivery was slow and hesitating at first, but became more confident as he went along.

"Ladies and gentlemen: On May 14th I contacted the President with regard to a suggestion concerning the present . . . ah . . . difficulty in which . . . ah . . . many of us find ourselves. Calculation indicates that the fission of lead liberates two billion electron volts of energy, or, in more familiar terms, one pound of lead will produce 3.96×10^{11} British Thermal Units. This process, in contrast to the fission of plutonium, may be caused to proceed at a moderate rate. The expenditure of a pound of lead is sufficient to evaporate forty-four million gallons of water. Since the annual production of lead is just short of a million tons per year, it is not difficult to see that a very large quantity of water may be evaporated. The technological problems are not of a too serious nature. I thank you."

The voice ended abruptly. Fred and I looked at each other blankly for an instant, and then the President's voice broke in, quite obviously extemporaneously.

"What Dr. Schneider means," he said a bit testily, "is that we may use atomic energy from lead to distill fresh water from the ocean for irrigation, until the Z-acid is gone from the ocean and normal evaporation can commence again."

Well, that was it. Fred and I literally jumped from our chairs, with most unacademic howls of joy, and completely missed the similar announcements made in French, Russian, Chinese and all the other languages of the globe. The public reaction throughout the world was, as you well know from history, a riot almost as devastating as a lead bomb. The relief was simply tremendous. For a couple of days nothing could be done toward implementing Schneider's proposal, because there was no labor available. Then everyone went to work.

The work was divided into two phases. The first job was the locating of tremendous stills along the coast adjacent to arable land, with pipe lines connecting them to the fields. The first system in operation, as I recall, was at San Luis Obispo, and opened the whole Salinas Valley to cultivation. The second was at Bombay. After that stills were set up by the thousands, until the inevitable bottleneck was reached in the manufacture of pumps and pipe lines.

When this point was reached, the second planned phase of the project began. Evaporation plants were set up at coastal locations where onshore winds prevailed, and immense jets of steam were simply shot into the air, to be carried inland. The first plants had little effect on the weather, but at last, after almost a thousand stations had been established along the California coast, the first dividends came, in the form of a cloud—a white, natural cloud—over the Sierra Nevada range.

People drove hundreds of miles to see that first cloud, and the others

which soon followed. And then, on the day that the six thousandth evaporation plant was set up, there was a thunderstorm in the mountains. As the precipitation moved to the valleys, people rushed from their homes to feel the raindrops. Men and women threw themselves into the gutters to soak up the first muddy water, and churches held open-air services in the rain.

The showers really weren't much, according to present-day standards. They were scattered and light; at its best, our artificial weather was very close to desert climate. But it made dry farming possible, and along with the irrigation stills and rigorous evaporation control, it brought back food production, first to normal, and then to a level beyond anything the world had ever seen before. For there was now a new factor present, which had never existed before, even in the lushest pre-drought years. That was the factor of world-wide human cooperation. For the first time in all history, everyone was working for the common benefit of humanity. For the first time thought and energy were directed away from war, and toward a constructive project. Where all the efforts of diplomats had failed, the grim necessity of survival succeeded. The heads of the States gathered to save themselves, and then, by a miracle, stayed together.

Well, there is little more for me to say tonight. You all know how the world has been transformed. Doctors Schneider and Ordway were both proclaimed heroes, and both created a sensation by being most embarrassed about the whole thing. I doubt if the public ever did understand the view which they took of the matter, although I believe that most scientists had some appreciation of the amazing way in which Providence, or at least something resembling that agency, stepped in, particularly with regard to the timing.

I think that there is no better way for me to close, than to quote a statement made by Schneider a few years ago, upon his retirement from the directorship of the ADA, which is, as you know, strictly honorary, as the ADA has little to do. He said earnestly:

"Dr. Ordway and I have always maintained that we are fraudulent heroes. Either of our discoveries, by itself, would have destroyed humanity. If they had been made at different times—even so little as a year apart—the end would have been disaster. The fact that they came together, and in such a way that their application could cause so much good, must remain in my mind the most wonderful coincidence in history. Either that, or we must assume that it was all the result of the conscious effort of some superhuman power. Which it was, I am not prepared to state."

THE END.

BOOK REVIEW

"Pilgrims Through Space and Time," A History and Analysis of Scientific Fiction. By J. O. Bailey, Ph. D. (*Argus Books, Inc.*, New York) Price $5.00.

Reviewed by Willy Ley.

After a delay of several years the long-announced history of science fiction, written by J. O. Bailey, a Ph. D. of the University of North Carolina, has finally appeared. It is the first publication of a new venture in publishing, called Argus Books, Inc., an offshoot of the Argus Book Shop.

It is also the first book expressly devoted to the tracing of science fiction through literature, although at this point it is already necessary to make certain reservations. The same job has been done before, although only for specific themes. The French astronomer Camille Flammarion published a rather fat book consisting almost exclusively of summaries of science fiction stories; naturally he put the emphasis on astronomical themes. Both the German and Italian biographies of Jules Verne contain several chapters on Verne's imitators and predecessors. Professor Philip B. Gove published a book called "The Imaginary Voyage in Prose Fiction" (New York, 1941) and Professor Marjorie Hope Nicolson published several excellent studies on the influence of scientific discoveries on contemporary literature—mostly in the "Smith College Studies" series.

But all these studies have the disadvantage of being either in a foreign language or out of print—and usually both—and some of them are, of course, rather old. For this reason Dr. Bailey's book has the two advantages of being in English and available, two laudable and useful qualities.

While reading the book one strongly feels a marked unevenness of the various sections, the reason for which is, presumably inadvertently, made clear on the dust jacket. It is stated there that the origin of the book was an essay entitled "The Scientific Novels of H. G. Wells," written by Mr. Bailey

as a M. A. thesis and accepted in 1927. This was followed in 1934 by a dissertation for the Ph. D. degree entitled "Scientific Fiction in English, 1817—1914; A Study of Trends and Forms." To this study a chapter or chapters on modern science fiction were added at the request of the publisher to make the present book.

This gradual development accounts for the major shortcoming of the book, its remarkable unevenness of style and conception. The book is still "Scientific Fiction in English, 1817—1914" and more particularly "The Scientific Novels of H. G. Wells," and that part—the present chapters Three to Five, pages 28-118—is good. The remainder, obviously pasted to the original dissertation both loosely and clumsily, ranges from poor to bad. After having finished the very short Chapter I, one still does not quite know why it is there. Chapter Six, which presumably deals with "modern" science fiction, deserves and will probably get both barrels of criticism from all interested quarters. The Chapters Seven to Ten are devoted to a detailed, tedious and quite repetitious analysis of story elements and devices, literary and otherwise. Because of the origin of the book this analysis leaves an unprejudiced reader with the impression that all science fiction was written by H. G. Wells, E. A. Poe, Olaf Stapledon and, yes, if you want to be lenient, also by Jules Verne. Jules Vèrne, incidentally, comes in for repeated chiding because of his "facetiousness"; Dr. Bailey seems to be an outstanding example of a Doctor of Literature minus any sense of humor.

A criticism of detail would have to comprise some forty typewritten pages; I'll therefore restrict myself to jabbing an accusing index finger at a number of omissions, picked more or less at random. Chapter Two is supposed to outline the development of science fiction from the earliest stories to the year 1817 and is neatly subdivided into "Wonderful Journeys," "Utopias and Satires" and "Gothic Romance." The "Wonderful Journeys," in turn, are subdivided into "On the Earth," "Into the Earth," "To Other Planets" and "Into the Future." To my immense surprise I found the section "On the Earth" to consist of one only, Tiphaigne de la Roche's "Giphantia." How about some of the earlier specimens quite well-known in literature? For example the "Tales of Odysseus of Ithaka at the Court of King Alkinoös," otherwise known as Books IX, X, XI and XII of the "Odyssey"? How about the Alexandre Romance? The Tales of Herzog Ernest of Svabia? The numerous tales about voyages to the Court of Prester John?

The sub-section "Into the Earth" consists entirely of Baron von Holberg's "Nicholas Klim"; needless to say it is by no means the only example of this type prior to 1817.

The following chapter is similarly subdivided for the period from 1817—1870 which is in itself a rather poor choice; the year 1850 would be a more logical dividing

line. The subdivision "Into the Earth" in that chapter is essentially devoted to the literary influence of the "theory" of that famous Captain John Cleves Symmes who in 1818, sent out a circular in which he pledged his honor as an officer to the truth that the earth is a hollow shell, open at both poles and habitable within. Dr. Bailey thinks that one of the earliest pieces of fiction devoted to that theory, the book "Symzonia" by "Captain Adam Seaborn" might have been written by Symmes himself. That is obviously not the case. Symmes just could not write, as is clearly shown by examination of scrapbooks from that time—they are in Philadelphia—and "Captain Seaborn," whoever he was, pokes fun at the theory repeatedly, for example when he says, at one point, that "bearing in mind the adventure of Captain Sinbad with the Mountain of Lodestone all nails holding the ship together were made of copper." And in the very last paragraph he disowns the whole adventure.

Dr. Bailey is careful to point out that Baron von Holberg's "Nicholas Klim" could not have been based on Symmes and wonders where von Holberg got the idea of a hollow earth with a small sun in the center, possibly circled by a few small interior planets. Quite simple, Dr. Bailey, the originators of that theory were Dr. Edmund Halley of comet fame and the German mathematician Euler.

In Chapters IV and V one is surprised to notice that the points of several Jules Verne stories are missed by about a mile. They also begin to accumulate a remarkable list of "missing persons" which reaches its climax in that ill-fated Chapter Six. Among the missing, prior to 1935, are virtually all the important foreigners. Alexey Tolstoy—not to be confused with Count Leo—is not mentioned. No German is present, neither Kurd Lasswitz nor Hans Dominik, nor Karl-August von Laffert, nor Thea von Harbou. The Dane Sophus Michaelis isn't there either. It can't be just a linguistic barrier, since some of their works have been translated, although mostly in Great Britain. Besides Alexey Tolstoy, Thea von Harbou and Sophus Michaelis appeared on the screen with some of their science fiction stories; the fact that there are science fiction films is not mentioned at all by Dr. Bailey.

And don't look for William Hope Hodgson, he isn't there.

The list of missing persons in Chapter Six is something to behold. In alphabetical order—and highly incomplete — the following men never exerted the slightest influence on science fiction: Isaac Asimov; John W. Campbell, Jr. (and Don A. Stuart); L. Sprague de Camp; Robert A. Heinlein (and Anson MacDonald); Will F. Jenkins (and Murray Leinster); Abraham Merritt and Stanley G. Weinbaum.

Omitting these men and the stories they wrote naturally narrows the field down quite a bit, but it is still possible to pick a large number of good stories by other authors and arrive at a reasonably satisfac-

tory picture of modern science fiction. Howevah . . . but you'll see. One of the stories discussed is "Tarzan at the Earth's Core," by Edgar Rice Burroughs; the first of the Pellucidar stories would have been a better choice. Another story discussed—of all things—is Otis Adalbert Kline's "Planet of Peril." Another one is Dr. E. F. Northrup's "Zero to Eighty" which, of course, is hardly a true science fiction story. If you are sufficiently thick-skinned you might be amused by Dr. Bailey's condescending remark that "the author is not without standing in scientific circles." No, the co-inventor of the Ajax-Northrup induction furnace certainly had some standing, and the statement should be in the past tense to begin with.

A. Hyatt Verrill's "Beyond the Pole"—from *Amazing Stories*, 1926—and Ray Cummings' "The Girl in the Golden Atom" are stated to be typical examples of modern science fiction. Of Dr. E. E. Smith's stories, not the Lensman series, but the "Skylark of Space" is summarized but not analyzed. I trust that my friend George O. Smith will forgive me—and he might even agree with me—if I say that "Identity" is one of his weaker stories, but that's the one Dr. Bailey picks as an example. If he had taken the first or the second of the Venus Equilateral stories, he would have had an opportunity to discuss a number of interesting technological concepts, but he did not do it. I strongly suspect that he would not be able to do so. Now in "Identity" there is, you may remember, an electronic "key," consisting essentially of a cavity resonator. The unwary reader of Dr. Bailey's book is left with the strong impression that a cavity resonator is a science fiction device which may or may not be invented some two hundred years from now.

"Pilgrims Through Space and Time" completely fails to convey a picture of recent science fiction. It completely fails to correlate the scientific discoveries and theories of a period with the fiction caused by these discoveries and theories. It fails to analyze the more important of the modern stories, and fails to do justice to those which are analyzed.

The final impression after laying the book aside is one of intense disappointment.

THE END.

THE ANALYTICAL LABORATORY

Space is really tight this issue. The ratings stand:

Place	Story	Author	Points
1.	Aesop	Clifford D. Simak	1.93
2.	Children of the Lens (HH) 71	E. E. Smith	2.00
3.	The Barbarian	A. E. van Vogt	2.96
4.	Age of Unreason	Alfred Coppel, Jr.	3.93
5.	The Dreamers	Michael Yamin	4.32

THE EDITOR.

BRASS TACKS

An article on calculators is on its way right now.

Dear Mr. Campbell:

1. Children of the Lens
2. Aesop
3. The Barbarian
4. Age of Unreason
5. The Dreamers

On the whole an excellent issue. Do you think that you might be able to get an article on the electronic digital computer? I am sure that it would be of great interest, as very little general interest material on this field has been published.—Richard A. Marble, Williamstown, Massachusetts.

Anyway you take it, the whole patent system needs a complete revision!

Dear John:

G. S. Curry's article, "What's Wrong With The Patent System" set down some material I've been fuming about for a long time. It also told me something I didn't know, and something which, I think, leads to conclusions just the opposite from some Mr. Curry draws.

As far as the individual inventor goes, the effect is just that stated. If he can't get a valid patent, either he won't invent or he'll try to keep his invention a secret. The situation of the large corporation, however, is different.

A really large corporation doesn't get patents in order to keep its competitors from using an invention. A large corporation gets patents for two reasons: so that someone else will not patent its ideas, and so that it will have something to trade to competitors for the use of their patents.

The first nightmare of a corporation is the individual inventor who, in the past, has often obtained a "paper" patent on a device not subsequently exploited which discloses some useful feature. Later, this feature inevitably appears in the art, often under some guise quite different from any the inventor had

in mind. If it weren't for the patent, all would be well along the path of progress. The "invention" has been worked out in the corporation's laboratory as a minor feature of a development program—but, alas, subsequent to the date of the patent. If the patent seems likely to be held valid, the corporation had best buy it. To protect themselves from such embarrassment, some corporations flood the patent office with all the details of the devices they think they may use. Large corporations seldom get anything from individual inventors but headaches.

In the past the patent office has been quite liberal in granting patents, and, apparently, the courts have been quite liberal in upholding them. If, however, it becomes almost impossible to get a valid patent, large corporations will no longer have to worry about individual inventors, and, believe me, that would give rise to some considerable sighs of relief.

What about patent trading between two or more corporations, leading to cross-licensing of each under the other's patents? This becomes necessary in a well-developed field, in which it is almost impossible to proceed without using material covered by many patents. Corporations, then, get patents on inventions which both they and their competitors will need, so that they will have something to trade with in obtaining the use of their competitor's patents. If, however, it should become virtually impossible to obtain a valid patent, a corporation would no longer have to rely on cross-licensing to enable it to prosecute its business, and this, too, would bring many sighs of relief.

Would lack of patent protection lead to secrecy on the part of large corporations? Try to keep the affairs of a large corporation secret—the technical affairs, at any rate! I'm not talking about mixing up a proprietary medicine, which can be done by a few chosen employees, but of making a complicated device such as a radio. Such secrecy as large corporations are able to exercise could probably not be maintained for a period longer than that between the filing of the application and the granting of a patent, the period in which the corporation is entitled to secrecy anyway. Very often, inventions are disclosed soon after filing, and long before the patent is granted. Such secrecy as is observed is a little to get a head start, but mostly to give time for exploration of the idea for more patentable features. The corporation fears that if it makes ideas public prematurely, some individual will pursue them further, get paper patents, and prevent the corporation in whose laboratories the invention was made from exploiting it fully.

On the face of it, it looks as if the Supreme Court's excursion into the metaphysics of invention is aimed at the laboratories of the large corporations. Mr. Curry seems to show, however, that its real effect is to depreciate the value of patents. This will certainly hit the individual inventor, but, if carried far enough, it will give corporations a desper-

ately needed relief from patent harassment. Is this historical necessity working itself out through the befuddled brains of the merely human justices of the Supreme Court?—J. J. Coupling

---

Your imp has the dope. No paper —No Unk. We're sorry too.

Dear Mr. Campbell:

Alejandro's cover for September was mouth watering. My wife and I both drooled over it. To praise this masterpiece of symbolism is beyond us, even though the little woman *is* an artist.

I have rated the contents of the October issue as follows: 1st: "The End Is Not Yet," a well planned tale that ended far too rapidly. Hubbard covered more time and events in the final installment than in the first two. A common weakness many writers have of getting a story out of the way by skipping many details in the final chapter.

2nd: "Target." Cartur packed a lot of punch in those seven and one quarter pages.

3rd: "Ole Doc Methuselah." A well-written rehash of an old topic.

4th: "What's Wrong With The Patent System?" Very interesting; even more so than the remaining two stories.

5th: Tie between "Problem in Solid," and "Collector's Item." Two impossible stories that should have found it impossible to get into Astounding.

Your Editorial on "Flying Somethings" is a very sensible bit of opinion on the subject.

Yesterday, after carefully placing a small, bulging, envelope in my jacket pocket, I quoted the following:

"If P equals not-Q, Q implies not P, which is equivalent to saying either P or Q but not both. But if not-P is not implied by not-Q, a conclusion can be drawn concerning the relation between two classes even if the evidence refers only to a part of some third class to which both are related. Whatever is predicated affirmatively or negatively of a class may be predicated in like manner of everything asserted to be contained in that class."

PFMP!!

I landed in Faerie, A.D. 1947.

I headed for the nearest newsstand.

Upon reaching same, I withdrew my envelope, with its precious contents, from my pocket. The contents I arranged in the form of a pentagon and were as follows: one vial each of black, red, yellow, and blue printers' ink; one piece of pulp paper; two wire staples; one vial of glue.

Having accomplished this, I lit a piece of incense of frankincense and myhrr . . . then I was ready . . .

Nervously, yet eagerly, I chanted the following:

"By paper, by ink, by staples and glue;
By Beelzebub's horns, and Siva's arms, too.
By token of sweat from the brow of deCamp,
Whose characters oft through those pages did tramp;

Assisted, we're told, by one Fletcher Pratt,
And Cartier's caricatures, ugly and fat.

Conjure up! Conjure up! Thou paper in reams,
And thus put an end to all of our dreams;
Giving us that for which we all cry:
The mag that's the apple of everyone's eye.
Pray come, ye gods, before the year's flown,
And give back to us our vaunted *UNKNOWN!!!*"

No sooner had I finished this mismetered masterpiece, when before me stood one of Cartier's hobgloblin creations.

Leering at me, and breathing the fumes of brimstone into my face, he spoke:

"Ha-a-a-a . . . humph-h-h-h!! Thou wouldst let thine gaze rest agayne on *UNKNOWN???* HO-O-O-H-OOOO!! Can it be that thou knowest not the reasons why ye do not yet see this magazine? Knowest thou the magazine which publisheth a mattress, lo, once every month? 'Twas I who deemed it wiser that the likes of you, oh mortal man, should read your belly full of tripe and nonsense now in your grasp, rather than read the dangerous truths, about my kind, as expounded by *UNKNOWN!*

"No my master. Though you call me, and would order me to reinstate your favorite magazine, such cannot be done. All available paper now goes to the contemporary who now publishes monthly. It cannot be otherwise!!! If it be within my powers, and the powers of my kin, thou shall not have thine *UNKNOWN*, lest it expose more of the ways of the likes of me. Let the so-called fantasy fiction thou can buy today fill thy belly, and a pox on thee!!"

WHOOOSSSSSSTTT!!!!!!!

He was gone.

I fell out of bed.

So, John, that's why our *UNKNOWN* is not yet back on the stands?

Is it??—Richard E. Simpson, Post Office Box 2, Gilmanton, New Hampshire.

Judging from past experience; it will be several years before any one-piece "Children of the Lens" appears!

Dear Sir:

Re: "Children of the Lens," by E. E. Smith in November Astounding Science Fiction:

I hate "to be continued" above all things in magazine stories. But I like ASF stories so much, and there are so few in any one issue, that my resolve to save Smith's until all four issues were at hand could not be kept.

I am now faced with these alternatives: 1. You tell me where I can buy a copy of the completed novel. 2. I can get relief by writing a sequel that will satisfy me, and perhaps others. As a lazy man I much prefer the former. Can do?

Suggestion: If S&S cannot afford to have more stories in each issue, why not make ASF a quarterly? It's better to get a bellyful four times a year than a mere sop each month.

But even for the sops, thanks a lot.—Eugene Scherpenberg, 208 E. 85 Street, New York, N. Y.

Or, as Bertrand Russell put it, "Is the class of all classes not members of themselves a member of itself?"

Dear Mr. Campbell:

Concerning Roland Silver's problems in the July Brass Tacks, Mr. P. Schuyler Miller—November Brass Tacks—*almost* solved both of them, but didn't quite solve either of them!

To take up the second problem first, his alternating series was correct, but he failed to observe that its sum is the natural logarithm of two, obtainable from the series expansion of Loge $(1 + X)$.

His remarks on the checkerboard problem were suggestive, but rather vague about showing a contradiction, which must be done very sharply to constitute a proof, so I shall submit two proofs to show that the problem cannot be solved.

First proof: Assume that the construction has been made. Then each of the rectangles used must cover exactly one white square and one black square. But this pairs off the white squares with the black squares, so that *there must be as many of one color as of the other*—the point Miller missed. This is, of course, an absurdity, which disproves our assumption that the construction is possible.

Second proof: Assume that the construction has been made. Obviously, each rectangle must be either vertical or horizontal. Now let us count the number of vertical rectangles, as follows:

In the bottom row of the altered checkerboard there are an odd number of squares; hence there must be an odd number of vertical rectangles projecting up from the first row. This leaves an odd number of uncovered squares in the second row, and so there must be an odd number of vertical rectangles projecting up from the second row. Continuing in this fashion, we find that there must be an odd number of vertical rectangles projecting up from the seventh row. Now the sum of seven odd numbers is an odd number, so we find that the total number of vertical rectangles must be odd.

As to the horizontal rectangles, we may reason in a similar fashion, proceeding from the left side of the board to the right, obtaining an odd number of horizontally placed rectangles.

But the sum of two odd numbers is even, and therefore the total number of rectangles used—vertical plus horizontal—must be an even number, which is absurd, since the covering of 62 squares without overlapping would require exactly 31 rectangles!

Well, if science-fiction fans want problems, let them strain—or

sprain!—their sutures on the following.

(1) Suppose that you are the only foreigner in the land of Cromwellia, where every native is either a Puritan or a Cavalier. Now every Puritan speaks only the truth, and every Cavalier always lies. One dark night you are walking a road, and dimly perceive that there are three people walking abreast ahead of you. It is too dark for you to tell whether they are Puritans or Cavaliers by their dress, but you hear the following conversation among them:

First man "I am a Puritan." Second man: "He says he is a Puritan." Third man: "Actually, of course, he is a Cavalier."

Question: How many Puritans, and how many Cavaliers are there in that group of three men?

(2) Suppose that you are given a rubber inner tube which is painted white outside and black inside. If you find that the tube has a small hole in it, can you deform the inner tube, without tearing it, so as to turn it inside out, i.e., so it will be black outside and white inside? By "deform" I mean stretching or shrinking, the shrinking being such that it can be "unshrunk," so to speak, by an ordinary stretching. The condition that tearing is not allowed implies, for example, that the inner tube may at no time assume a shape that can be stretched or shrunk into a cylinder, and that no more holes may be made.

(3) Can you stretch a flat rubber band around the handle of a broomstick three times, so that it will lie flat against every surface it touches, including the places where it touches itself?

(4) Suppose you are given a simple balance which weighs things only by showing equality when you have placed equal weights in each pan. Now it is possible to weigh all the integer weights from one ounce to forty ounces with this balance and four standard weights. What are they?

(5) Let us define a *self-membered* class as a class which contains itself. For example, the class T, containing all things which are *not* tables is a self-membered class, for it is not itself a table, and so must contain itself. The class of all classes is also self-membered.

Now it is obvious that any given class is either self-membered or it is not, in which case we shall call it an *ordinary* class. One example of an ordinary class would be the class, F, defined as the class of all Ford cars.

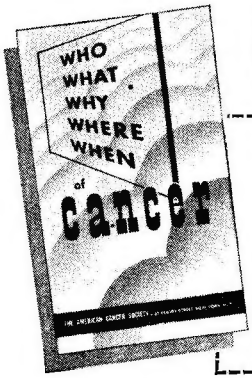
Here is the problem: Consider the class O, defined to contain all ordinary classes, and only ordinary classes. Is O a self-membered class, or is it an ordinary class?

Let me warn the prospective solver that some of these problems are *tough!* However, if you have forgotten your school math, you should still be able to give a pretty thorough discussion of all of them except the fourth.

Another tough problem, which I haven't been able to solve yet, is, "When is that first word going to be dropped from the title of A.S.F.?"—Philip Geffe, 241 So. Holliston Avenue, Pasadena 5, California.

Learn to recognize...

Only your doctor can diagnose cancer—*but you can suspect it.* Be on the look-out for cancer's danger signs. Remember that most cases can be cured if treated in time. For the safety of yourself and family, be informed. Send for the free book that gives the facts about cancer. Use coupon.



AMERICAN CANCER SOCIETY
47 Beaver Street, New York 4, N. Y.

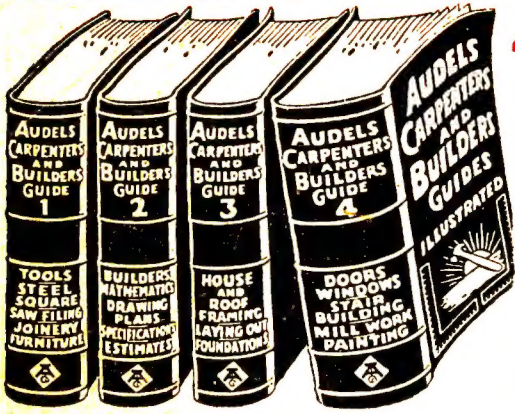
Please send free booklet by medical authorities.

Name.....

Address.....

City.....*State*.....

AUDELS Carpenters and Builders Guides 4 vols. $6


AUDELS CARPENTERS AND BUILDERS GUIDE 1
TOOLS STEEL SQUARE SAW FILING JOINERY FURNITURE
AUDELS CARPENTERS AND BUILDERS GUIDE 2
BUILDERS MATHEMATICS DRAWING PLANS SPECIFICATIONS ESTIMATES
AUDELS CARPENTERS AND BUILDERS GUIDE 3
HOUSE AND ROOF FRAMING LAYING OUT FOUNDATIONS
AUDELS CARPENTERS AND BUILDERS GUIDE 4
DOORS WINDOWS STAIR BUILDING MILL WORK PAINTING
AUDELS CARPENTERS AND BUILDERS GUIDES
ILLUSTRATED

Inside Trade Information for Carpenters, Builders, Joiners, Building Mechanics and all Woodworkers. These Guides give you the short-cut instructions that you want—including new methods, ideas, solutions, plans, systems and money saving suggestions. An easy progressive course for the apprentice and student. A practical daily helper and Quick Reference for the master worker. Carpenters everywhere are using these Guides as a Helping Hand to Easier Work, Better Work and Better Pay. To get this assistance for yourself, simply fill in and mail FREE COUPON below.

Inside Trade Information On:

How to use the steel square—How to file and set saws—How to build furniture—How to use a mitre box—How to use the chalk line—How to use rules and scales—How to make joints—Carpenters arithmetic—Solving mensuration problems—Estimating strength of timbers—How to set girders and sills—How to frame houses and roofs—How to estimate costs—How to build houses, barns, garages, bungalows, etc. —How to read and draw plans—Drawing up specifications—How to excavate—How to use settings 12, 13 and 17 on the steel square—How to build hoists and scaffolds—skylights—How to build stairs—How to put on interior trim—How to hang doors—How to lath—lay floors—How to paint.

AUDEL, Publishers, 49 W. 23rd St., New York 10, N. Y.

Mail Audels Carpenters and Builders Guides, 4 vols., on 7 days' free trial. If OK I will remit $1 in 7 days and $1 monthly until $6 is paid. —Otherwise I will return them. No obligation unless I am satisfied.

Name_____

Address_____

Occupation_____

Employed by_____ JACK